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Procedure in Examination of the Lungs

WITH ESPECIAL REFERENCE
TO THE DIAGNOSIS OF TUBERCULOSIS

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THIRD EDITION

REVISED AND WITH A PREFACE

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PREFACE

In the last three decades, medicine has made such gigantic strides in various fields, that we have learned to keep an open mind, and adjust our views to the light of newly presented facts and discoveries. Authors of medical text-books have, therefore, found it difficult to preserve the freshness of their point of view, in certain fields, from time of planning to the time their manuscripts appeared in print. Apart from the medical classics, there appears a volume on some medical phase from time to time which claims a permanence in interest, and preserves a perennial freshness. "Procedure in Examination of the Lungs," by the late Dr. Arthur F. Kraetzer, is one of such fortunate publications.

It is true that the subject of physical diagnosis of chest diseases has been firmly established since the turn of this century. It is quite conceivable, however, that even a volume on physical diagnosis written ten years ago might be found wanting in clearness of presentation, or thoroughness of detail, in the light of our present day knowledge of diseases of the lungs. It is precisely because no such deficiencies can be imputed to this book, that it may be truly asserted the author's thorough grasp of the subject, his keen appreciation of the needs of the medical student, and his foresight regarding the trend of newer knowledge of diseases of the lungs, enabled Dr. Kraetzer to give

us an exposé of the subject which will be authentic and timely as long as physical diagnosis will remain part of the machinery for the diagnosis and differentiation of the various diseases of the lungs.

Both in the introduction and the text, the author has stressed particularly the importance of physical signs in relation to the timely diagnosis of Pulmonary Tuberculosis, but, incidentally, he has described a thorough method of differentiating other important diseases of the lungs and pleura, from Tuberculosis.

The author of this book emphasized the orthodox sequence of method, namely: Inspection, Palpation, Percussion and Auscultation in the examination of the chest, but he so enlivened the text with pertinent examples that he convinced this reader, at least, that each method when exhaustively exploited has great diagnostic value in its own right. The author is particularly to be commended for succeeding in bringing considerable order out of the chaos of rules. Of the four methods of physical examination, auscultation is admittedly the hardest for the student to master in relation to normal findings, and nigh bewildering in relation to abnormal signs over heart or lungs. The task has certainly not been made easier by the confusion, overlapping, and duplication usually found in the literature concerning rules. In this little volume, rules are not only sensibly classified, but are fixed in the student's mind in relation to the underlying pathology, by a rational explanation of the origin of each kind.

Physical signs, of course, are not alone sufficient for a

positive diagnosis of Tuberculosis or other lung diseases. The x-ray has come to play a very important role in the diagnosis of chest diseases. The visual evidence, which the x-ray film furnishes, is a temptation to relegate physical signs to an unimportant place in the diagnostic equipment. I heard one phthisiologist once say, half humorously, I hope, "Give me good x-ray films of the chest, and I am willing to throw my stethoscope into the ocean." I would not try to belittle the value of the x-ray in the diagnosis and follow up in Pulmonary Tuberculosis, as well as in other lung affections. But let us not forget that all the x-ray can show is shadows, and shadows are not always so explicit that 'one who runs may read'. In fact, shadows over the lung fields are often so baffling that the experienced phthisiologist finds them difficult to interpret. We read the true condition in those shadows oftener in the light of the history of the illness and physical signs. There are, of course, cases of Pulmonary disease with a considerable amount of pathology — and this is frequently true of Tuberculosis — which yield no helpful signs. On the other hand, physical signs when present may give us a clue to the true nature of a particular lung involvement, when the shadows over the lung fields are not too distinctive. This is particularly true in a case of Bilateral Pulmonary Tuberculosis, when collapse therapy is considered. The shadows over the lung fields may seem equally important, and it is by way of the stethoscope one decides which side is pathologically active, hence on which side to attempt a pneumothorax.

This book is particularly valuable, because its author has not lost sight of these discrepancies. He has, accordingly, given Physical Diagnosis its deserved place in the diagnostic scheme, while, emphasizing the importance of a reliable history, the x-ray examination, Bronchoscopy where indicated, and laboratory aids.

In the author's own perspective, therefore, "Procedure in Examination of the Lungs" commends itself as an indispensable aid to all medical students, and is a book which can be perused with profit by practicing physicians.

J. SEGAL, M.D.

PREFACE TO THIRD EDITION

In introducing a revised edition of *Procedure in Examination of the Lungs*, I feel impelled to offer the reader, in advance, a few answers to questions which he may wish to ask when he reads this book. Thus anticipating the reader, it occurs to me that he might question whether I actually meant all that I had written in the preface to the previous edition, if after all a revision has now become necessary. My answer is that I see no inconsistency in the two tasks. All that I have said about this book in a former preface is as true today as it was then, but progress in clinical medicine since publication of the first edition, rather than change in procedure in the examination of the lungs, has made a revision desirable. One disease entity, for example, tuberculous tracheo-bronchitis, had not been definitely described before 1934. An auscultatory sign over the chest now identified with this condition cannot reasonably be expected to have been specifically described in a text written in 1930. Again, diagnostic aids which had been newly introduced at about that time have since become integral parts of the diagnostic investigation of lung affections, and can no longer be dismissed with a mere note of reference.

Precisely for the reason given in my former preface —

needed to bring more expert advice and more extensive experience to bear on the problems involved. Many of our text-books have made the examination of the chest far too complicated, and Dr. Kraetzer has made a real contribution in simplifying the methods involved.

It must be borne in mind, however, that physical signs are by no means always the most important evidence in making a diagnosis of pulmonary tuberculosis. In many, if not the majority of cases, the diagnosis should be suspected at least, if not really made, from the history alone, and in so many cases does it occur that physical signs are very scanty or absent or perhaps not pathognomonic, that if a student or physician acquires a habit of relying upon physical signs for diagnosis, many mistakes will result. As Dr. Kraetzer well points out, it is the question of suspicion aroused by the points brought out in the story which should lead eventually to the correct diagnosis, and this suspicion must not be lulled to sleep in the absence of unequivocal physical signs. Repeated examination, careful study of the story, x-ray studies and sometimes prolonged observation may be needed.

It is a very real problem which faces the medical profession and for the solution of which it alone is responsible. Too often the criticism of the laity against the profession for failure to make early or correct diagnoses is well founded. Dr. Kraetzer's little book is an important step in the right direction and should prove very useful to students

JAMES ALEXANDER MILLER, M.D.

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Unfortunately the trend of the times and the improvement in mechanical methods have been detrimental to skill in physical examination. An x-ray friend of mine, after complimenting me on the first edition of this book, remarked with a cynical smile that a mediocre radiologist could make a better diagnosis of tuberculosis than an expert clinician. This is partially true but it carries an implication which is not true. It would be the height of old fogyism to limit oneself to the stethoscope, but the skilled physical examination will bring out precise and delicate points that are completely inaccessible to the x-ray. Furthermore it is impossible to acquire an intimate understanding of pulmonary pathology without knowledge of physical signs. Besides this, x-ray pictures are expensive and frequently may be unavailable. After all there is still such a thing as family practice in the home. Socialized Medicine hasn't abolished it all yet. To expend arduous toil in acquiring technic in an out-moded method would be the last word in pedantry. The physical examination, however, is far from out-moded.

The purpose of examination of the lungs is obviously the diagnosis of lung conditions, and, in a book dealing with this subject, every pulmonary problem must find a place. In the delineation of diagnostic method a book must be an *organic* unit, and from the purely teaching point of view one disease is as important as another. From the practical aspect, however, the crowning glory of the work in hand would be to facilitate the early diagnosis of tuberculosis, and upon this element especial emphasis is laid.

Procedure in Examination of the Lungs

CHAPTER I THE ACTUAL SOUNDS

AREAS TO BE COMPARED

Percussion

- a Resonance or duration of sound.
- b Pitch of percussion note

Auscultation.

- a Intensity or relative loudness
- b Length of expiratory sound
- c Pitch of inspiratory sound
- d Quality of breath-sounds

ORIGIN OF THE SOUNDS

CAVERNOUS AND AMPHORIC BREATHING

TECHNIC OF PLESSION

The purpose of this chapter is to furnish the medical student with an actual, objective critique of his percussive and auscultatory findings, and to give not an arbitrary but a comparative and synthetic description of what he hears. It is in no sense a syllabus of physical diagnosis but is merely a practical method of developing technique and giving the student a system of defining a given sound, that may confuse him, by comparing it with other known and constant areas on the chest. The regular routine of inspection, palpation, etc., and their diagnostic significance

II. AUSCULTATION

Compare the points, 1, 2, 3, 4, in that order, with respect to:

(a) *Intensity, or relative loudness.* — As a rule, intensity of breath-sounds will increase in the order 1, 2, 3, 4. "Four" will always be louder than all the rest, and "three" will always be louder than "two". "One", however, sometimes may be louder than two or three. Remember that anybody can decide which of two sounds is the louder. You do not have to be a Laennec for that.

(b) *Length of expiratory sound.* — This, without exception, will increase in the order 1, 2, 3, 4. Over "one" you may hear no expiratory sound whatever, and this is perfectly correct. At times, particularly in young individuals, you may hear a very considerable expiratory sound. This is not to be confused with bronchial breathing. The distinction soon will be made clear.

(c) *Pitch of inspiratory sound.* — Listen to the inspiratory sound and immediately remove the stethoscope so as not to hear the expiration, shifting it to the area next in order in time to catch the succeeding inspiration. The pitch will rise in the order 1, 2, 3, 4. At this point one precaution is necessary. As was mentioned above, "one" may at times be more intense or louder than "two" and "three". Do not mistake increased intensity for relatively higher pitch. It is an easy pit to fall into. We hear loud sounds more readily than less loud sounds, and high-pitched sounds more readily than low-pitched. Be-

cause of this factor of easier audibility, common to loud sounds and high-pitched sounds, we may jump to the false conclusion that a relatively louder (more intense) sound is relatively higher pitched, whereas it is merely louder and actually may be lower pitched. The difference in pitch of the inspiratory sounds, taken by itself, is of little value diagnostically. As an exercise in technique, however, its recognition is of the greatest importance.

The foregoing three properties of breath-sounds are quantitative in their nature and are defined according to quantitative standards. The sound is louder or less loud. It is longer or shorter. It is of higher or lower vibration-frequency, i.e., higher or lower pitched. The next property, as its title indicates, is not quantitative but qualitative. The variations of this property are "*sul generis*" and simply must be learned as such. Even here, however, there is a quasi-quantitative transition of one quality into another

(d) *Quality of breath-sounds*, or degree of approximation to the hollow quality of "four", which is the tracheal sound — "One" will possess none of this quality. The quality of "one" is known as vesicular, because it is supposed to arise in, or be transmitted through, unimpaired air-vesicles. It may be described best as a gentle, unobtrusive rustle, as of myriads of microscopic leaves. If you attempted to represent it graphically, you would do so with a multitude of minute dots, or stippling, if sound ever can be visualized as being stippled. The tracheal tone, however, over "four", is a purely homogeneous, hol-

CHAPTER III

INSPECTION

General appearance.
Position of trachea
Respiratory excursion
Asymmetry of muscles.
Shape of chest
Clubbing of fingers

GENERAL APPEARANCE

Have the patient sit in a comfortable, easy, erect position, directly facing you, with the hands in the lap and the muscles relaxed. Note the general nutrition and the type of physique. The classical "habitus phthisicus" is a lantern-jawed, long-necked, flat-chested piece of architecture. Very frequently, however, we find the exact reverse of this type, namely, a rounded, plump, well-nourished individual with a tendency toward feminine configuration and markings, what is sometimes referred to as the "hypo-pituitary type." When this type has tuberculosis, it seems to be of the active parenchymatous variety with rapid spread and cavitation and little tendency to arrest. It is extraordinary how well nutrition may be preserved in this type of patient, even with extreme involvement.

Next, note whether the patient "looks sick". A case

with considerable tuberculous consolidation sometimes may look surprisingly comfortable, whereas if the consolidation be that of pneumonia, he will always be very obviously ill, dyspnoëic and febrile. If there are marked dyspnoëa, cyanosis and collapse, with extraordinary and urgent distress, suspect pneumo-thorax or pulmonary embolism.

POSITION OF TRACHEA

Next, note the position of the trachea. Drop an imaginary plumb-line from the notch in the thyroid cartilage and make a pen-mark where it strikes the episternal notch. It should strike almost precisely in the mid-line. Normally there may be an almost imperceptible deflection to the right, but if the deflection to the right is obvious, or if there is any deflection at all to the left, then the trachea is displaced, either from an ipso-lateral pull from scar tissue, or contra-lateral push from hydro- or pneumo-thorax. Lung tumors do not tend to displace the trachea unless they are very extensive. At times, however, the thyroid cartilage may be asymmetrical, and the plumb-line method may lead to wrong conclusions.

A more reliable and really easier method is to note the depressions between the lower end of the trachea and the lower ends of the two sterno-mastoids respectively. One of these depressions may look more filled in, the other correspondingly more scooped out. The filled-in side is the side toward which the trachea is displaced (Fig 2).

CHAPTER IV PALPATION

Respiratory excursion
Tactile fremitus.

RESPIRATORY EXCURSION

Spread the fingers of both hands and place them lightly on both sides of the upper chest, the forefinger just below the clavicle, the other fingers approximately on the successive ribs. Have the patient breathe rather deeply in and out. In the young, normal, flexible chest, the second, third, fourth and fifth fingers will rise one after the other in the order given. In the senile or emphysematous chest, the fingers rise almost simultaneously. Note whether one side of the chest lags behind the other, and whether there is any inequality of excursion. Either of these findings is suggestive of disease on the side of delayed or limited excursion. Even a slight apical lesion may cause limited excursion on the diseased side.

TACTILE FREMITUS

In testing for tactile fremitus, apply to the chest that part of the palm which is just proximal to the fingers

It seems to be more sensitive to vibration than the latter, possibly because it can be held against the chest more steadily and with less muscular strain. Use both hands, but use them one after the other. Do not apply them simultaneously. Shifting the same hand from one side of chest to the other takes too long. It makes you apt to forget just how strong the vibration felt. Have the patient say "ninety-nine" in a moderately loud, deep voice. The resulting vibration, felt by the hand on the chest, is known as tactile fremitus. Always compare symmetrical areas. Tactile fremitus is normal, increased, decreased, or absent. Normally it is slightly but definitely greater on the right than on the left side, particularly over the upper lobe. In this event it is incorrect to say that it is "increased" on the right, or "decreased" on the left. If the difference is more marked than you think it ought to be, then you have to make up your mind:

1. Whether the difference is more marked than normal
This you do by recalling normal chests previously examined,
2. Whether it is increased on the right, or
3. Whether it is decreased on the left.

This distinction may be hard to determine, but it is by no means purely academic. Of course, if the change is in the reverse order, i.e., if the tactile fremitus is greater on the left than on the right, the question is much easier to answer, and we know that we are dealing with an abnormal finding. In general, increases in tactile fremitus are more difficult to recognize as such and are more ambiguous in

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CHAPTER V

THE HEART IN RELATION TO PULMONARY EXAMINATION

Mitral stenosis simulating pulmonary tuberculosis
Displacement of heart away from diseased side
Displacement of heart toward diseased side.

Before percussing the lungs, it is logical to interpolate the examination of the heart. In fact, this may just as well be done at the very start. In any event, it is essential to go over the heart *before any further examination of the lungs is made*, because by so doing, misconceptions and lost motions will be avoided. It is not pleasing to one's vanity, for example, in a case with cough, fever, hemoptysis, dyspnoea and night sweats to harge blindly into auscultating the lungs, and, on hearing a number of generalized moist rales, make a diagnosis of advanced tuberculosis with fatal prognosis, when examining the heart at the proper time would have disclosed the presystolic murmur of mitral stenosis and have established the lung condition at once as chronic passive congestion with entirely different outlook and treatment. One function of technic, secondary to the paramount one of serving the patient, is to spare ourselves as many intellectual upsets as possible. We get sufficient in the normal course of

events. Another and most essential reason for examining the heart before percussing and auscultating the lungs, is to determine the position of the cardiac borders and the apex-beat with possible pulmonary conditions in mind. If, without cardiac enlargement, the borders and the apex-beat are shifted, be quite sure that there is some pulmonary or pleural pathology. In such an event, refer back to your findings with respect to the position of the trachea and note whether this corresponds. The position of the trachea and the position of the heart are useful checks on each other. Rarely you may find the trachea displaced in one direction and the heart in the other, for example, a large cavity at the apex pulling the trachea over, and a large effusion at the base on the same side pushing the heart away.

DISPLACEMENT OF HEART AWAY FROM DISEASED SIDE

The heart is displaced away from the diseased side in:

1. Pleurisy with effusion,
2. Pneumo-thorax.

DISPLACEMENT OF HEART TOWARD DISEASED SIDE

The heart is displaced toward the diseased side in:

1. Marked fibrosis, and by inference, extensive cavitation, because it is generally only around large cavities that we get enough scar-tissue to exert a really considerable pull. This cavitation may be

the result of tuberculosis, bronchiectasis or abscess.

2. Massive pulmonary collapse. The key-finding in this post-operative condition is the displacement of the apex-beat toward the affected side. If this is not noted and given its due weight, the other findings, dullness, diminished breath-sounds and fremitus, almost invariably will be interpreted incorrectly as fluid or post-operative pneumonia.

CHAPTER VI

PERCUSSION

Dullness at the apices
Flatness at the apex
Flatness at the base
Obliteration of Traube's tympany.
Tympany over a small area
Tympany over an extensive area
Amphoric resonance
Hyper-resonance
Percussion of the back
Demonstration of the diaphragmatic excursion.
Grocco's triangle

First of all, always compare symmetrical points on the chest, remembering that the right top normally shows impairment of resonance. Carefully mark out with a skin-pencil, Kronig's isthmuses in the supra-clavicular spaces. Note if either or both are shrunk. Such a finding results from the retraction of lung parenchyma which is associated with tuberculosis. Decide whether the dullness at the right apex is of normal or more than normal intensity. This is always more difficult to determine than dullness at the left apex, which is always pathological. If the dullness at the right apex is associated with narrowing of Kronig's isthmus, it is pathological. Having decided that one area of the chest is dull as compared with the corresponding area on the other side, percuss that area

locally and determine its boundaries, marking them with a pencil. The lower limit of apical dullness generally is determined more easily by percussion from below upward than from above downward. Slight grades of dullness at the apex also are recognized more easily by this method. Note whether the area of dullness is sharply demarcated or whether it tends to peter out at the periphery, sug-



FIGURE 1.

gesting a corresponding petering out of the underlying pathology. Note especially whether the area of dullness corresponds to some definite anatomical entity, such as one of the lobes or one of the interlobar fissures. If the former, think of the pathology that may have lobar distribution (lobar pneumonia, pneumonic phthisis). If the latter, think of interlobar effusion or empyema. Keep your mind open, however, until the examination is complete. Recall what you found when testing for tactile fremitus. Dullness, associated with normal or increased

tactile fremitus, suggests infiltration, consolidation or cavity. Dullness associated with decreased or absent tactile fremitus suggests thickened pleura, effusion, or a cavity surrounded by marked pleural thickening. The greater the dullness and the less the fremitus, the more apt it is to be fluid than thickened pleura. If pleural effusion is present, careful percussion often will show the upper



FIGURE 2 Compare the two depressions between the trachea and the lower end of the sterno-mastoid muscles, depicted in the diagram by shading. Note if one depression is more filled in and shows less shadow than the other. If so, the trachea is displaced toward that side. The depression away from which the trachea is displaced will look more scooped out and show more shadow.

border to follow a curved line, lowest anteriorly and posteriorly and highest in the axilla, like an enormous meniscus. In hydro-pneumo-thorax, however, the fluid seeks its own level, and the corresponding upper limit of dullness will be horizontal and will shift readily with change in position. In pleurisy with effusion, change in position causes little if any shift of dullness. Dullness at the top,

exception, namely, that *unduly hard* percussion over a normal apex may elicit tympany from the large bronchi.

If tympany is localized to a small area of the chest, generally it will be at one of the apices, and, incidentally,

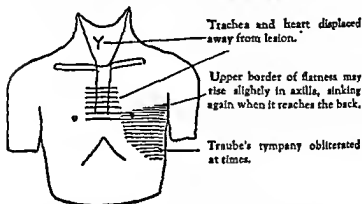


FIGURE 5. Flatness at the Base.

- | | |
|-------------------|--|
| <i>Inspection</i> | 1 Diminished to absent respiratory excursion on side of lesion |
| | 2 Trachea and apex-beat pushed away from side of lesion
Apex-beat may not be visible |
| <i>Palpation</i> | 1. Diminished to absent respiratory excursion on side of lesion |
| | 2. Diminished to absent tactile fremitus over base on side of lesion |
| <i>Percussion</i> | 1 Flatness over base on side of lesion, the upper border of the flatness perhaps rising slightly toward the axilla |
| | 2 Traube's tympany obliterated at times in left-sided effusion |

Diagnosis of pleural effusion is established on the above findings

generally is not recognized. Localized at an apex, it means cavity. Cast your mind back over what you have discovered under inspection and palpation. Appropriate

PERCUSSION

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coincidental signs would be deflection of the trachea toward the side of the lesion, diminished expansion on the side of the lesion, increased (or decreased) tactile fremitus over the lesion, displacement of the heart toward the side of

Trachea pulled toward side of lesion.

Tympany at the apex.

Dulness below the tympany.

Cardiac borders pulled toward side of lesion.

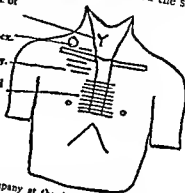


FIGURE 6 Tympany at the Apex

Inspection

- 1 Diminished respiratory excursion on side of lesion
- 2 Trachea and apex-beat pulled toward side of lesion

Palpation

- 1 Diminished respiratory excursion on side of lesion
- 2 Tactile fremitus may be unchanged or increased, but will probably be diminished as a result of marked fibrosis

Percussion

Tympany at apex, with dulness below shading into normal resonance

Diagnosis of cavity is established on the above findings

of the lesion (Fig. 6) The tactile fremitus gives little or no information in this situation

If, however, there is extensive tympany on one side of the chest, reaching from apex to base, then an entirely different situation probably is present (Fig. 7). Again, review what you have already found Inspection probably

will have shown the patient to be in severe shock and intensely dyspnoëic. The involved side will show diminished or absent respiratory movement. The other side will show respiratory movement greatly exaggerated, both relatively and absolutely. Heart and trachea will be displaced markedly away from the tympanitic side. If the lesion is on the left, the left cardiac border and apex-beat may be displaced almost to the sternum, or even beyond. Over the tympanitic side, tactile fremitus will be greatly diminished or absent, if the patient is in condition to co-operate. The final confirmatory finding will be reached under the head of auscultation. The breath-sounds will be decreased, absent, or, rarely, amphoric. This combination of findings means pneumo-thorax. Horrible to relate, frequently it is diagnosed as pneumonia. Suspecting pneumo-thorax, now carefully percuss the involved side from the axilla toward the sternum, marking the skin where a change in note occurs, not a change from tympany to dullness, but a change from tympany to less marked tympany. These marks should fall in a roughly vertical line, about in the position of the mid-clavicular line. Whenever the points representing change in percussion-note fall uniformly into an approximately geometrical line, it always arouses the suspicion of something anatomical corresponding to it. What approximately corresponds to this particular line is the border of the collapsed lung. Between this line and the sternum there is still a considerable degree of tympany, because between the collapsed lung and the chest-wall in

this area there is still a layer of air. It is only when you come to the heart that actual dullness is found, and this may not occur until the sternum is reached, so remarkably

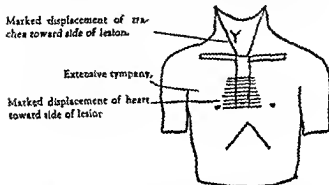


FIGURE 8. Extensive Tympany on One Side of the Chest from Apex to Base

<i>History</i>	Long, chronic illness. No acute catastrophic onset
<i>Inspection</i>	1 Markedly diminished or absent respiratory excursion on side of lesion 2 Marked displacement of trachea and heart toward side of lesion
<i>Palpation</i>	Confirms 1 and 2 of Inspection Tactile fremitus normal, increased, diminished or absent, usually the last, as result of extreme fibrosis
<i>Percussion</i>	Extensive tympany over half of the chest.

Diagnosis of enormous cavity is established on these findings. Note the correspondence on the findings, with one exception, to those occurring in pneumo-thorax. The crucial differential point is the displacement of the mediastinum toward the side of the lesion.

may the heart be displaced. Here again we are reminded very forcibly of the vital importance of examining the heart very early in the game.

I have said that extensive tympany on one side of the

the existence of emphysema, you will have to be more than usually alert not to miss them.

Percussion of the back follows the same general rules laid down above, but has a few special features of its own. From the apex to the angle of the scapula posteriorly, the percussion-note is less resonant than in front, because of the anatomical peculiarities, thick muscles, the angles of the ribs and the scapulæ. Light percussion and careful comparison of symmetrical points are in order. The scapula may be moved partly out of the way by having the patient put his hand on his opposite shoulder, and then raise his elbow out forward. Below the angle of the scapula the percussion-note is very resonant.

Always percuss out the lower margin of the lungs, the patient breathing very quietly, and draw a line marking the transition from resonance to dullness. Check by auscultating immediately above and below this line. The breath-sounds will be audible above, practically inaudible below. Now have the patient draw in a full breath and hold it, while again you percuss and draw a line. This line will be considerably below the first. Now have the patient breath out as far as he can and hold it, while you percuss and draw. This line will be above the first. The space between the uppermost and lowermost lines corresponds fairly well to the excursion of the diaphragm. You will be surprised how considerable it is. Watch the diaphragmatic excursion through the fluoroscope. You will see nothing more than you have demonstrated already by the humble method of percussion. If the space between

the uppermost and lowermost lines is less on one side than on the other, i.e., if the diaphragmatic motion is limited on that side, look for disease in that half of the chest. Remember that the right base is normally demonstrably higher than the left, owing to the presence of the liver (Fig. 9).

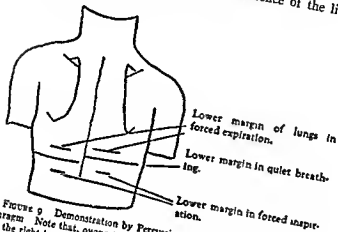


FIGURE 9 Demonstration by Percussion of the Excursion of the Diaphragm. Note that, owing to the presence of the liver, the lower margin of the right lung is always a little higher than that of the left.

Grocco's Triangle — If you have demonstrated dullness at one base, percuss out the lower margin of the opposite lung and mark it. Then carefully percuss toward the angle between the mid-line and the lower margin of the normal lung, percussing from without inwards, and then checking by percussing from above downwards. If a triangle of dullness is found filling this angle, it is known as Grocco's triangle and is diagnostic of fluid in the oppo-

spiration. This is not only distracting, but makes it difficult to estimate the expiratory sound correctly. Be sure that no extraneous sound is produced in the mouth or throat by air vibrating against tense or too closely held lips, against the teeth, the tongue, or the soft palate. Have the patient clear his throat and do all his swallowing before you start. It is very annoying to have the patient swallow saliva during auscultation. Very often it makes a sound like rales. Some patients, either through stupidity or through innate contrariness, never can learn to breathe the way you want. Sometimes they have stiff, muscle-bound chests. Very often they are trying too hard to help you. They feel that they have to do something and hold their bodies too stiffly erect, breathe too harshly, shrug their shoulders, or make noises in their mouths and throats. They cannot grasp the fact that you want nothing but passivity plus a slightly sharper inspiration. Show them what you want, and they will always try to improve on it. You simply will have to make the best of it.

COMPARISON OF APICES

Now, starting in the supra-clavicular spaces, auscultate successively symmetrical points on the entire anterior and lateral chest, comparing them with respect to the four points mentioned in the first section, intensity, length of expiratory sound, pitch of inspiratory sound and quality. Pay particular attention to the supra- and infra-clavicular regions and the apices of the axillæ. The normal differ-

ences between the two sides you are familiar with. Have these questions constantly in mind:

- A. Are the normal apical differences in this particular chest exaggerated in degree?
- B. Are the apical differences reversed from the normal?
- C. Are abnormal sounds heard in the middle and lower parts of the chest?

This last question is easy to answer and requires no discussion. The first question is harder to answer than the second. For example, you have found, as you always do, normally, broncho-vesicular breath-sounds at the right apex. It may be either normal or abnormal. Ask yourself this question: "Are these broncho-vesicular breath-sounds which I hear at the right apex of normal degree, or are they too close to the bronchial? Is the difference between the right and left apex more marked than it ought to be?" There are three legitimate answers, namely.

1. The broncho-vesicular breath-sounds at the right apex are of normal degree,
2. They are of more than normal degree;
3. I do not know.

The last may be a perfectly correct answer, and the sooner you acquire judicious ignorance the sooner are you on the path to wisdom. Human vanity, however, may take curious forms. It may express itself in false humility just as well as in pomp of the flesh and cocksureness of spirit. When you say you do not know, be sure that the circumstances are not those in which you very well ought

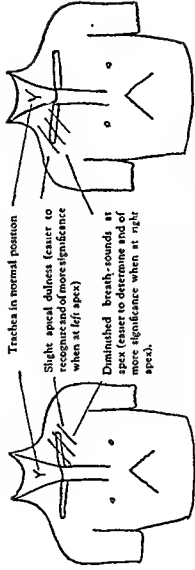


FIGURE 11. Dullness and Diminished Intensity of Breath-Sounds at Either Apex.

toriloquy, is the equivalent of a bronchial breath-sound, and, occurring over an area where the breath-sounds are so diminished as to be unidentifiable, if not actually inaudible, will betray the existence of pathology corresponding to bronchial breathing, namely, marked infiltration, consolidation or cavity. Over areas where there are frank broncho-vesicular or bronchial breath-sounds, increased whisper will be found in the former case and true pectoriloquy in the latter, with one important exception, and that a very fortunate one. At times over the apices of a very emaciated patient, you may hear breath-sounds which are almost bronchial and yet without any underlying pulmonary pathology. In such cases you will not get the clear-cut increase in the whispered voice which you might be led to expect, but only the degree of increase normally found at the apices, i.e., slight, or possibly, especially on the left side, no increase in whisper at all. If, however, these almost bronchial apical breath-sounds are such as a result of pathology and not merely because the chest is thin, then you will get your pectoriloquy according to Hoyle. The same differentiation between pathological and non-pathological broncho-vesicular breath-sounds at times may be necessary over the lower half of the left hilum and likewise can be determined by the presence or absence of pectoriloquy. Pneumonia of the left lower lobe may be wrongly imagined present, if this is not remembered, for over the large bronchi in this location broncho-vesicular breath-sounds sometimes

The spoken voice is not nearly so valuable or so delicately precise as the whispered voice. It corresponds to the latter, being increased by condensation, consolidation or cavitation. It is diminished by anything that insulates the lung from the ear such as fluid, air or thickened pleura. In its extreme form of exaggeration spoken words can be audibly recognized and it is then known as bronchophony. Bronchophony of a nasal, squeaking, goat-like quality is known as egophony and though not often present usually corresponds to a spot just below the level of an accumulation of fluid, although it may occur over consolidation. It is not a sign of much value.

Auscultate with particular care all areas with abnormal palpation or percussion findings. These areas should have been marked out with a skin-pencil. They are particularly apt to show abnormal auscultatory signs. It is a good plan to compare the whispered voice in symmetrical areas over the entire chest. Increased whisper over any place but the apices and the main bronchi is abnormal.

Diagnosis should not be allowed to rest on any one finding, but should be the resultant of all findings. Some of the individual findings are of a high degree of significance. For example, dullness and broncho-vesicular breath-sounds at the left apex are not merely consistent with tuberculosis, but almost certainly mean tuberculosis. However, it is not sufficient merely to diagnose the existence of tuberculosis. The extent and pathological nature of the tuberculous lesion must be determined also, for on this depends prognosis. For this we need a synthesis of

all available data, including history and x-ray findings. Sometimes even these are not enough

This discussion of the possible percussive and auscultatory differences at the two apices has taken considerable time, for the simple reason that the permutations and combinations in an interpretative sense are somewhat numerous. In actual examination, however, a very few minutes are needed

We will now take up individually the various auscultatory findings which may turn up and attempt to correlate them with what has gone before. As you see, the process of correlation is becoming more involved by a sort of geometrical progression, but it is exactly what should go on in your mind during the examination of a chest, and the actual application is much more expeditious than the description

- A Normal breath-sounds.
- B Exaggerated breath-sounds.
- C Diminished breath-sounds

A. NORMAL BREATH-SOUNDS

Normal breath-sounds are heard over normal lungs and may be heard over lungs that are considerably involved with disease. Normal breath-sounds do not rule out pathology by any means.

B. EXAGGERATED BREATH-SOUNDS

Exaggerated breath-sounds are characterized by greater loudness, and the expiratory element may be more in

C. DIMINISHED BREATH-SOUNDS

When, however, we come to diminution of the intensity of the breath-sounds, then we are dealing with something of much greater import. Strange to say, students have a great way of fighting shy of this sign. They seem to have an inborn aversion against recognizing it. When they run across it, they often seem to think that they are simply having a harder time than usual with their ears or their stethoscopes. This sign is by no means diagnostic of the presence of disease, but it is always suggestive. Rarely, I have found it in chests where no pathology could be demonstrated. As a suspicious sound to a vigilant sentry, this sign always should arouse the mental cry of, "Who goes there?" So important is diminution of the breath-sounds, that I will devote an entire chapter to its discussion. With the possible exception of rales, it is the sign of signs. Diminution of breath-sounds almost invariably means that there is pathology of some sort or description, and yet time and again it escapes recognition, apparently solely because it is less obtrusive, and because we seem to feel that abnormal auscultatory findings should be played on the brasses and not on the wood-winds. It is because of this superlative importance of diminution of the breath-sounds, that this book's introductory chapter insists on learning how to recognize varying degrees of intensity as they obtain in the normal chest.

CHAPTER VIII

DIMINISHED INTENSITY OF BREATH-SOUNDS

I DIMINISHED INTENSITY OVER A CONSIDERABLE PART OF ONE SIDE OF THE CHEST

A *The area of diminished breath-sounds is resonant*

- 1 The patient is not in pain and is not dyspnoic.
Apical tuberculosis Artificial pneumo-thorax
Cavity Hemiplegia
- 2 The patient is in pain and is not dyspnoic Intercostal fibrosis Pleurisy
- 3 The patient is dyspnoic and may or may not be in pain
 - a Displacement of mediastinum away from side of lesion Pneumo-thorax
 - b. No displacement of mediastinum Pneumonia Pulmonary embolism Local dullness may develop later.

B *The area of diminished breath-sounds is dull*

- 1 The area involved is at the base
 - a Mediastinum displaced from side of lesion Effusion Empyema Hydropneumo-thorax
 - b Displacement of mediastinum toward side of lesion Adhesive pleurisy Cavity. Abscess. Bronchiectasis Massive collapse
 - c. No displacement of mediastinum Effusion, small or encapsulated. Fibrosis. Neoplasm.
- 2 The area involved is at the top of the chest.
Tuberculosis, Upper lobe pneumonia Neoplasm

II DIMINISHED BREATH-SOUNDS OVER A SMALL AREA (Apex, Base, Intermediate area) TUBERCULOSIS ENCAPSULATED FLUID THICK PLEURA, ABSCESS

I will discuss diminished intensity of breath-sounds under two heads:

Trachea in normal position

Rales are conclusive.

Slight apical dulness (easier to recognize and more significant when at left apex).

Greater diminution of breath-sounds at apex than at base (easier to recognize and more significant when at right apex)

Diminished breath-sounds over a considerable part of one side of chest.

Diminished respiratory excursion may be present

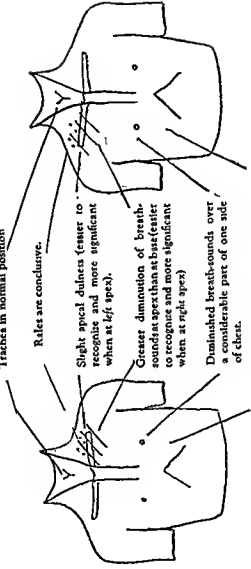


FIGURE 11.

**FIGURE 12 I Diminished Breath-Sounds Over a Considerable
Part of One Side**

A The area of diminished breath-sounds is resonant (except perhaps at the apex)

x The patient is not in pain and is not dyspnoeic

Diagnosis Without apical rales tuberculosis is suggested With apical rales, tuberculosis is certain.

may cause diminished breath-sounds over the entire side of the chest through a viscero-motor reflex analogous to that which causes spasm and rigidity over an inflamed appendix. If there are pathological changes in quality, then the greater the degree of bronchiality and pectoriloquy, the more advanced is the transition from mere infiltration to consolidation or cavity (Fig 12).

There is another condition in which you may find this combination (I, A, 1.), and this is artificial pneumothorax, or at times even spontaneous pneumothorax, the acute stage of which has passed. The first stage of spontaneous pneumothorax is accompanied almost invariably by the most profound distress or even collapse. An extensive area of resonance, which is often of a distinctly tympanitic quality, plus marked diminution or even absence of breath-sounds, means pneumothorax. If this combination turns up, refer back to what you discovered under inspection of the trachea and palpation and percussion of the heart. Displacement of the trachea and heart *away from* the side of resonance and markedly diminished breath-sounds, confirm the diagnosis of pneumothorax. As for quality, the diminished breath-sounds, if audible at all, may or may not be amphoric, and there may be pectoriloquy or amphoric whisper (Fig 13).

There is yet another possibility. Wide-spread diminution of breath-sounds over a resonant chest, without pain or dyspnœa, plus displacement of the trachea and heart *toward* the side of the lesion, means an enormous cavity

Reduced Breath-Sounds Over a Considerable Part of One Side

Reduced breath-sounds is resonant

no pain and is not dyspnoeic

expiratory excursion on side of lesion

equal (relative and absolute) of respiratory ex-
cursion on other side

displacement of trachea and heart away from
lesion

1, 2, and 3 of Inspection

Crackles absent over side of lesion

Hyper-resonance over side of lesion

Trachea markedly displaced away from side of lesion

Reduced breath-sounds over side of lesion. Exceptionally

may be very distant amphoric or cavernous breath-
sounds or amphoric whispered voice

These are the three crucial signs of absent breath-sounds,
displacement of the mediastinum away from the side

of thorax. The absence of dyspnoea means that the
lesion is artificial, or spontaneous after the initial period

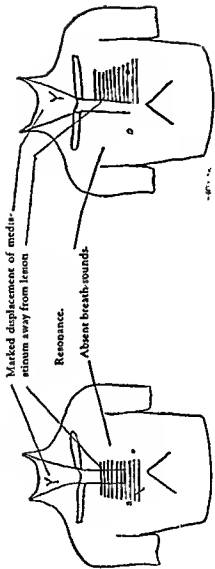


FIGURE 13.

shows that the resonance of the diseased side is of a tympanic, rarely of an amphoric, quality. Very careful percussion from the axilla toward the sternum shows a slight change in note somewhere in the neighborhood of the mid-clavicular line corresponding approximately to the border of the collapsed lung. The displacement of the heart may be extreme. A left-sided pneumothorax may push the left cardiac border over to the left sternal margin and the apex-beat over to a point midway between the right nipple and the sternum. A right-sided pneumothorax may push the right cardiac border over to the left sternal margin and the apex over to the left axilla. The breath-sounds still may be absent or may be faintly amphoric. If the patient is able to co-operate, an amphoric whisper may be demonstrated. The coin-sound, a detestable sign, may be present. My animus against the coin-sound is for this reason. It is very exasperating to an enthusiastic and artistic instructor to give a student a case of artificial pneumothorax to diagnose, have him get a fool hunch right at the start and look for the coin-sound. Having found it, he escapes the austere but fruitful inductive discipline which alone can stimulate his observing and reasoning powers and proceeds by the intellectually degrading method of deduction to demonstrate all the signs in the catalogue, and all this with a confounded air of self-satisfaction that is to the highest degree annoying. It may be magnificent, but it does not make for the progress of the world.

If the patient recovers sufficiently to give you any kind

One side of the chest is not moving as freely as the other side, is resonant to percussion and shows marked diminution or absence of breath-sounds. The other side of the chest shows exaggerated motion and a compensatory exaggeration of breath-sounds, which you must be on the alert not to mistake for bronchial breathing. First of all, look to the heart.

I. Diminished breath-sounds over a considerable part of one side.

A. The area of diminished breath-sounds is resonant.

3. The patient is dyspnoeic and may or may not be in pain.

a The trachea and heart are displaced.

If the heart and trachea are displaced away from the side of diminished breath-sounds, then you are dealing with a spontaneous pneumothorax, which, by implication, probably means tuberculosis (Fig. 7). The next step is to give, parenthetically, a good husky dose of morphine and atropine. Any further manipulation of a patient in the parlous first stage of spontaneous pneumothorax is unpermissible. Later on, if he survives and is more comfortable, the front of the chest may be examined with greater detail. But note, that the systematic approach which we have just described is sufficient for accurate diagnosis in this situation of intense emergency. Later, supplementary examination will disclose the following. Tactile fremitus on the diseased side, if the patient is able to co-operate sufficiently to demonstrate, is absent or markedly diminished. Careful percussion

shows that the resonance of the diseased side is of a tympanic, rarely of an amphoric, quality. Very careful percussion from the axilla toward the sternum shows a slight change in note somewhere in the neighborhood of the mid-clavicular line corresponding approximately to the border of the collapsed lung. The displacement of the heart may be extreme. A left-sided pneumothorax may push the left cardiac border over to the left sternal margin and the apex-beat over to a point midway between the right nipple and the sternum. A right-sided pneumothorax may push the right cardiac border over to the left sternal margin and the apex over to the left axilla. The breath-sounds still may be absent or may be faintly amphoric. If the patient is able to co-operate, an amphoric whisper may be demonstrated. The coin-sound, a detestable sign, may be present. My animus against the coin-sound is for this reason. It is very exasperating to an enthusiastic and artistic instructor to give a student a case of artificial pneumothorax to diagnose, have him get a fool hunch right at the start and look for the coin-sound. Having found it, he escapes the austere but fruitful inductive discipline which alone can stimulate his observing and reasoning powers and proceeds by the intellectually degrading method of deduction to demonstrate all the signs in the catalogue, and all this with a confounded air of self-satisfaction that is to the highest degree annoying. It may be magnificent, but it does not make for the progress of the world.

If the patient recovers sufficiently to give you any kind

patient may die practically instantaneously from shock, or a few hours later from a swiftly developing pulmonary œdema. The process, however, need by no means be so dramatic, and if the patient survives, as he frequently does, there may develop in the course of a day or two an area of dullness, bronchial breath-sounds, bronchial whisper and moist rales, small in extent and rather difficult to determine unless you make a special search for it. Pain is a very frequent concomitant of embolism, and fever generally is present for a few days. The reason that pain sooner or later is a fairly constant characteristic of pulmonary embolism is the fact that the embolism causes a wedge-shaped infarct at the periphery of the lung, the base of the wedge being the visceral pleura. This surface promptly develops pleurisy and pain results. The probability of the diagnosis is increased by the presence of a potential source of emboli. Occasionally, a few moments after an intra-muscular injection of an insoluble drug, such as mercury or bismuth salicylate, the patient may experience in mild or severe form the symptoms just described, plus a metallic taste in his mouth. Generally he survives, but he may be very ill for a couple of weeks. Such a situation means pulmonary embolism of the injected drug. It is a disconcerting experience.

I Diminution of breath-sounds over a considerable area on one side of the chest.

B. The area of diminished breath-sounds is dull to percussion.

Unfortunately this picture cannot be given the circumstantial classification used before. The possibilities are too numerous, and there is too much overlapping of signs and symptoms. The best frame of reference on which to hang our findings in the solution of "I, B," is the position of the involvement, i.e., whether it is in the upper or the lower part of the chest. Having established this as a point of departure, a convenient secondary division will be according to the position of the trachea and heart, whether normal, or displaced away from, or toward, the side of the lesion. This matter of the position of the heart always keeps bobbing up. It is impossible to lay too much emphasis upon it. If the heart has been examined at the start, a great deal of mental effort will have been rendered unnecessary, and a considerable factor of error and lost motion eliminated. The tentative scheme of mental approach is as follows:

- I. Diminution of breath-sounds over a considerable area on one side of the chest
 - B. The area of diminished breath-sounds is dull to percussion.
 1. The area involved is at the base,
 - (a) The heart and trachea are displaced *away from* the side of the lesion,
 - (b) The heart and trachea are displaced *toward* the side of the lesion,
 - (c) The heart and trachea are in *normal position*.
 2. The area involved is at the top of the chest.

I. Diminished breath-sounds over a considerable part of one side.

B. The area of diminished breath-sounds is dull to percussion.

1. The area involved is at the base.

a. The heart and trachea are displaced away from the side of the lesion (Fig. 14).

The patient may or may not be dyspnoëic. Inspection shows diminished excursion on the affected side. Palpation confirms this and in addition shows markedly diminished or absent tactile fremitus. The tactile fremitus may, exceptionally, fail to show this significant reduction. Percussion shows flatness or marked dullness at the base, merging into merely impaired resonance and then resonance from below upward. The upper border of dullness is not horizontal, but is slightly curved above like an enormous meniscus, the peak of which is apt to be in the lateral part of the chest. The breath-sounds are absent or markedly diminished, but may be audible, though diminished, in the upper, more resonant part of the chest. Somewhere in the neighborhood of the upper border of dullness there may or may not be a small area of diminished bronchial breath-sounds or increased whispered voice. This combination of signs means fluid in the pleural cavity. A confirmatory finding is the presence of Grocco's paravertebral triangle of dullness, which is found in the angle between the spinal column and the base of the opposite lung, and is caused by displacement of the mediastinum. If the patient shows a normal or merely



FIGURE 15

There may or may not be displacement of trachea and heart. If present it will be away from the side of the lesion.

Diminished respiratory excursion
Possibly impaired resonance
Diminished breath-sounds

Absent tactile fremitus, usually.
Flatness, in elongated oval, from axilla to nipple

Absent breath-sounds

A small area of pectoriloquy may be found somewhere in the neighborhood

I Diminished breath-sounds over a considerable part of one side.

B The area of diminished breath-sounds is dull

I. The area involved follows an interlobar fissure

(a) The heart and trachea may or may not be displaced. If displaced it will be away from the side of the lesion

Inspection 1 Diminished to absent respiratory excursion on side of lesion

2 Exaggeration, relative and absolute, on other side

3 Displacement of heart and trachea may or may not be present. If present it will be away from side of lesion

Palpation Confirms 1, 2 and 3 of inspection

Tactile fremitus usually diminished or absent, but may be overlooked. Palpate again after percussion.

Percussion 1 Possibly impaired resonance above site of lesion

2 An elongated elliptical band of dullness or flatness running

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especially if the clinical picture is suggestive. A characteristic situation would be fever persisting after a pneumonia should normally have come to a crisis. Having found such a band of dullness test it again for tactile fremitus

Auscultation 1 Diminished breath-sounds, perhaps over entire chest, but certainly over band of dullness

2 Possibly pectoriloquy somewhere in the neighborhood of the band of dullness

Diagnosis interlobar effusion, serous or purulent. Paracentesis is definitely indicated to differentiate.

moderately increased pulse and temperature, the fluid is probably serous, *and this means tuberculosis in the vast majority of cases.* The books say it means tuberculosis in 80 per cent. of cases, but do not pay any attention to the books. The presence of serous effusion means tuberculosis, unless you can disprove it, and the odds are a hundred to one that you cannot. Serous effusion, with nothing else to back up your opinion, is almost as pathognomonic of tuberculosis as is the finding of bacilli in the sputum. Any attempt to side-step this inscrutable and inexorable fact springs either from ignorance or from moral and intellectual cowardice. It is a diagnostic crime that time after time has led to disaster.

If the temperature and pulse are high with marked toxemia and leukocytosis, with history of sudden onset or precedent pneumonia, look for empyema. So-called unresolved pneumonia frequently turns out to be pus in the pleural cavity.

The above combination of signs may be limited to, or more definitely obvious in, a wedge-shaped area in the neighborhood of one of the interlobar fissures. Think of interlobar fluid, either serum or pus. Or the signs may have an atypical extension, the margins not being referable to anatomic considerations. In such an event think of encysted effusion, delimited fortuitously by adhesions, again signifying either serum or pus, and again still involving the differentiation between tuberculosis and surgical empyema. If your examination has shown a pneumo-thorax, be sure to look for fluid at the base. The

signs over the fluid will be as just described, except that the upper level of dullness will be horizontal instead of slightly convex and will shift readily with change of position.

N.B.—In pleural effusion, particularly if interlobar, the contra-lateral displacement of the heart may be absent or so slight as to escape notice. In this event we depend for our diagnosis largely upon the diminution or absence of tactile fremitus

I. Diminished breath-sounds over a considerable part of one side

B. The area of diminished breath-sounds is dull to percussion.

1. The area involved is at the base.

b The heart and trachea are displaced toward the side of the lesion (Fig. 16).

The determining feature of this group of findings being the displacement of the heart and trachea toward the lesion, the question arises as to what is the nature of the pathological process, which is competent to accomplish such an effect. There are two processes which can do this:

(a) An extensive scar-tissue formation, which, by its gradual contraction, pulls the mediastinum over toward it,

(β) A process involving a reduction in volume of the affected lung, without the latter being separated from the chest wall. In this case, the heart and trachea are not pulled toward the lesion, but are

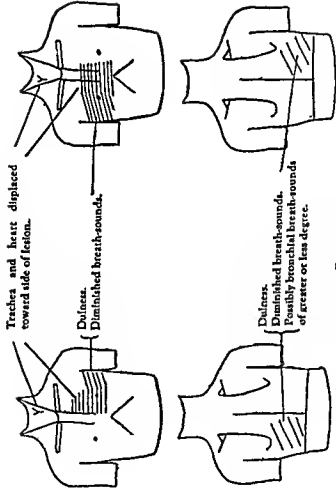


FIGURE 16.

FIGURE 16. *1 Diminished Breath-Sounds over a Considerable Area on One Side of the Chest.*

B The area of diminished breath-sounds is dull to percussion.

1 The area involved is at the base

(b) The heart and trachea are displaced toward the side of the lesion

The above combination of findings is consistent with

(1) *A very extensive fibrous pleurisy* (Sequel of acute fibrous or serous pleurisy, empyema, or pneumonia) There may be a palpable or audible friction There are no changes in the quality of the breath-sounds The displacement of the mediastinum, if present at all, is slight and is only present if the pleural fibrosis is marked

(2) *Cavity.*

a History of rather stormy onset about a week after operation or inhalation of foreign body Septic fever Cough and expectoration that soon becomes foul and profuse and separates on standing into three layers Clubbing of the fingers almost always takes place and is established in a short time Repeated sputum examinations invariably are negative for tuberculosis Dullness may be slight in extent and hard to find The only invariable physical sign is diminution of the breath-sounds, and this may be missed as a result of the usual prejudice against finding this sign Other auscultatory signs are conspicuous by their absence, possibly a small patch of distant bronchial breath-sounds or pectoriloquy, and possibly a few localized moist rales The heart becomes considerably displaced as the disease progresses Physical signs, if present, will probably be more marked at the back of the chest *Diagnosis, Pulmonary abscess*

b History of chronic cough, and profuse, sometimes foul, expectoration, separated into three layers

History of recent operation or trauma Heart displaced toward lesion

Slight dullness at base Breath-sounds diminished in intensity, possibly

distantly bronchial in quality *Diagnosis, post-operative atelectasis, or*

massive collapse Almost always mis-diagnosed as post-operative pneu-

monia

Criterion by which the diagnosis can be made *Diagnosis, basal tubercu-*

losis, third stage Very rare without involvement of the upper lobe

(3) *Reduced volume of affected lung, without separation from chest-*

wall

History of recent operation or trauma Heart displaced toward lesion

Slight dullness at base Breath-sounds diminished in intensity, possibly

distantly bronchial in quality *Diagnosis, post-operative atelectasis, or*

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History of recent operation or trauma Heart displaced toward lesion

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monia

Criterion by which the diagnosis can be made *Diagnosis, basal tubercu-*

losis, third stage Very rare without involvement of the upper lobe

the heart toward the side of the lesion

pushed toward it by the predominating expansive effect of the normal lung on the other side.

The first type of displacement may occur to a limited extent as the result of a very considerable chronic adhesive pleurisy which itself may be *non-tuberculous in origin* (history of acute fibrinous pleurisy, pneumonia or empyema). The history plays an important part in the decision. It is with cavity formation, however, that we find that very high degree of scar-tissue formation which is needed to effect a really obvious displacement of the mediastinum. Associated with the cavity formation, we generally find a considerable amount of chronic adhesive pleurisy, which may mask the signs of the underlying condition. The chronic adhesive pleurisy, *per se*, may cause:

- (1) Dullness, extensive in area and more or less marked in degree depending on the thickness of the layer of scar tissue,
- (2) Diminution of breath-sounds and tactile fremitus, the diminution again being proportional to the degree of fibrosis,
- (3) A palpable or audible friction-rub,
- (4) Diminution of the excursion of the diaphragm, described under the examination of the back,
- (5) Slight or moderate displacement of the heart toward the side of the lesion.

Under this smoke-screen of signs, we search for cavity, remembering that, *if the heart is obviously displaced*, cavity of some sort probably is present. If, one to two

weeks following an operation, or following the suspicion of having inhaled a foreign body, which possibility always must be inquired into scrupulously in the case of small children and must be suspected even when the results of the inquiry are negative, if, with such precedent circumstances, the patient has begun to sicken and in the course of a few days shows high temperature, rapid pulse, leukocytosis, cough with expectoration that usually quickly becomes profuse and foul, dyspnoea and cyanosis, and you find the signs mentioned under our present heading, you are probably dealing with a pulmonary abscess, and upon your alertness and openness of mind may depend the life of your patient. Of course, at first, displacement of the heart will be in abeyance, for it is only after considerable tissue-reaction and scar-formation have set in that such displacement can occur. But, keep looking for it. The sputum may not be foul, but this must not deceive you into the conventional mistake of diagnosing the condition as pneumonia. Superficially the two diseases may resemble each other, but in abscess the onset is slightly more gradual, and the temperature is definitely septic. In pneumonia the onset tends to be more explosive and the temperature unremitting. Pneumonia, unless complicated by empyema, typically ends by crisis somewhere around the ninth day. The symptoms of abscess, on the other hand, persist. Empyema itself may be difficult to rule out, particularly in the early stages. It generally gives rise to the fairly definite signs of fluid, which, if present to any degree, is apt to displace the heart *away from the*

shallow breathing with diminished ventilation. An accumulation of mucus may plug up a large bronchus, almost always at the base. The tributary area of vesicles is deprived of ventilation, the contained air becomes absorbed, the vesicles collapse, their walls adhere and a large area of atelectasis results. The involved lobe becomes reduced in volume, and the heart is pushed over toward it by the predominatingly expanded normal lung. Rolling the patient on the sound side and getting him to cough will sometimes cause a sudden clearing up of the condition. Inducing hyperpnœa by administering carbon dioxide sometimes will have the same effect.

I. Diminished breath-sounds over a considerable part of one side.

B. The area of diminished breath-sounds is dull to percussion.

1. The area involved is at the base.

c. The heart and trachea are in normal position.

This grouping is easily summed up. It includes all the pathology grouped under "I, B, 1 (a)", and "I, B, 1 (b)". In the former instance the effusion is not large enough to displace the heart perceptibly away from the lesion. In the latter instance the fibrosis is not of sufficient degree to draw the heart toward the lesion. Each case will have to be decided on its merits, without reference to the position of the heart. Besides these, however, there are two conditions showing the above signs, in which, with one infrequent exception, it is intrinsically impossible for the

heart to be shifted. Given an acute, stormy onset, with high fever, cough, possibly rusty sputum, pain in the chest, dyspnoea and leukocytosis, this combination of signs means *pneumonia*. In fact, even the dullness may be lacking, the only physical signs at the onset being diminished breath-sounds and diminished respiratory excursion. In the course of twenty-four hours a few fine rales may be heard, and after another day bronchial breath-sounds may enter the picture. The dullness and bronchial breath-sounds may be considerate enough to establish themselves over a reasonably accurate lobar distribution, but this is not apt to happen. Very frequently they are in evidence only over a small patch. The ubiquitous exception, referred to above, is that in very young children the increased compensatory ventilation of the sound lung rarely may displace the mediastinum toward the diseased side.

The second of the two conditions in which it is impossible to get displacement of the heart, is insidious in onset. The only symptoms may be an unobtrusive cough without expectoration, slight but progressive loss of weight and strength and a very gradually decreased ability to undergo effort without dyspnoea. The dullness is of very high degree, even to flatness, and may be of an easily determined lobar distribution. Diminution of breath-sounds and tactile fremitus is quite definite. There is generally no change in the quality of the breath-sounds, although increased whisper may occur. The diagnosis is almost certainly *pulmonary neoplasm*.

tile in the shape of a tuberculosis sanatorium. And yet, for the life of me, I do not see how this case could have been diagnosed except by the actual course of the disease. The only answer is to be super-normally alert all of the time, and, if you are working in a tuberculosis ward, not to be overwhelmed by the psychological momentum of that fact.

Another diagnostic possibility, consistent with the above group of findings, is upper lobe neoplasm. Highly suggestive diagnostic points in such a case are chronicity without displacement of the mediastinum. A tuberculous lesion of considerable chronicity and extent would be especially apt to pull the mediastinum over.

I, B. *The area of diminished breath-sounds is dull; the area is small (apex, base, intermediate area).*

If the small area of diminished breath-sounds is at the top, tuberculosis is the most likely possibility and must be considered present until ruled out. In fact, this is one of the earliest signs of tuberculosis, although it is in no sense pathognomonic, but must be supplemented by other data such as hemoptysis or rales. It is quite obvious that the earliest suspicious sign of tuberculosis is one whose recognition must be sedulously cultivated. Nevertheless, this one particular sign-post is overlooked more than any other. None but the expert seems capable of recognizing and appraising it. And yet all that it involves is the decision as to which of two breath-sounds heard over symmetrical points on the chest is less loud. The difference in loudness will be no greater, no more subtle, no

more difficult to establish, than that between the normal right and left apices. If recognition of the latter has been conscientiously acquired according to the scheme described in the introductory chapter, then this crowning and yet so easily attained subtlety of auscultation will fall within your grasp.

If the area of diminished breath-sounds is at the base or in an intermediate position, think of fluid, thickened pleura or abscess. Fluid in an intermediate area of necessity would be encapsulated or interlobar. Finding such a deposit and confirming its presence with the needle gives the thrill that all true intellectual adventure grants. Pulmonary abscess, unlike bronchiectasis, is notoriously parsimonious of physical signs. Just this small area of diminished breath-sounds is the only really constant finding in this condition. Pneumonia or infarct may be present. Remember that physical examination is an inductive process. The final diagnosis is the resultant of all data that have been collected before, including past history, present symptoms, inspection, palpation, percussion and auscultation.

CHAPTER X

RALES

DIFFERENTIATION

The geography of the rales

- 1 Rales at the base, (a) bilateral, (b) unilateral.
- 2 Rales at the apex
- 3 Generalized rales
- 4 Rales over the hilum
- 5 Rales of lobar distribution
- 6 Rales over intermediate and unclassifiable areas

The actual type of rale

A Dry rales

- 1 Sibilant
- 2 Sonorous
- 3 Fine dry

B Moist rales

- 1 Fine moist
- 2 Medium moist.
- 3 Large moist
- 4 Consonating
- 5 Moist musical
- 6 Mucous clicks

Respiratory phase of rales.

C Pleural friction

D Muscle sounds

"Facilis descensus Averna.

Sed revocare gradus superasque evadere ad auras,

Hic opus, hic labor est."

Virgil was doubtless thinking of rales when he wrote these lines. Rales are an easy subject to start discussing, but a mighty hard one to get out of with a whole skin. One fundamental fact to be remembered in the first place,

in the middle and all the rest of the time, is that a given rale does not connote automatically a particular type of pathology. It is the constant and strained effort to endow a particular rale with a specific and invariable significance that has caused the confusion in which the entire subject is involved. To do so is to lay down an attractive major premise from which we can reason deductively, and therefore easily. It is perfectly legitimate, if the major premise is 100 per cent. correct. But this major premise is sufficiently shy of being 100 per cent. perfect to get us into serious difficulties when we have once committed ourselves to it. It is a "*facilis descensus Averno*", and more

The most general statement that we can make about rales, that at the same time is accurate, is that rales represent either inflammation or transudation. This is not saying much, because inflammation and transudation are about all that can happen to a lung. To determine which process is present, and if the former, what kind of inflammation, we adopt three criteria, which are hereby laid down in the descending order of their importance:

- I. All the data that have gone before under symptoms, inspection, palpation, percussion and changes in breath-sounds.
- II. The geography of the rales, whether at the top, hilum, base, or some intermediate and unclassifiable area of the lung, whether unilateral or bilateral, whether localized or generalized; whether few or many.

III. The actual type of rale itself, whether dry, moist (fine, medium or large), sibilant or sonorous

A fourth and often essential criterion of the significance of given rales is the x-ray, but this does not concern us here. The x-ray itself likewise must be interpreted in terms of all the preliminary data. It is becoming obvious that a true critique of physical signs bears a certain analogy to the critique which modern mathematics imposes upon Euclidean geometry. Euclidean geometry is 100 per cent. correct providing its axioms are 100 per cent. correct. Modern analysis has shown that these axioms are not above suspicion.

II. THE GEOGRAPHY OF THE RALES

1. Rales at the base,
 - A. Bilateral,
 - B. Unilateral.
2. Rales at the apex.
3. Generalized rales (synthesis of 1 and 2).
4. Rales over the hilum.
5. Rales of lobar distribution.
6. Rales over intermediate and unclassifiable areas.

1. *Rales at the base.* — The limitation of rales to the base is first of all strong presumptive evidence against the pathology in question being tuberculous. Basal tuberculosis does indeed exist, but it is rare, and in general it cannot be diagnosed without a positive sputum

A. *Bilateral basal rales.* — If, at the extreme lowermost

margins of the lungs, deep breathing brings out a few, very fine, dry rales, which disappear after a few deep breaths, we are dealing with the ordinary non-pathological marginal atelectasis of the over-fed and under-exercised. The incomplete ventilation of the lung-margins causes the walls of a few of the most distal vesicles to cohere. The unwonted deep inspiration pulls these opposed walls apart with resulting rales

If, however, these extreme basal rales are more numerous and larger (fine, moist or medium moist), or more extensive than ordinary atelectatic rales should be, and if they do not clear up after a few deep breaths, they must be due to something of a more permanent nature than vesicle collapse from disuse. Such rales must be suspected strongly of being the pulmonary œdema of chronic passive congestion, the first sign of mild chronic cardiac failure, particularly in cases of hyperpiesia past middle life.

Sibilant rales or sonorous rales, at both bases, with the history of a present or recent acute cold, mean acute bronchitis. Such rales frequently are transient and may clear up on a few deep breaths or coughs. Hence you may catch them only on one side, or, if you have auscultated the chest from above downward in the usual way, may miss them altogether. For this reason it is best, in the presence of an acute respiratory infection, to listen at the bases first. Here again we see the necessity of constantly synthesizing what you are looking for now with what you have found before.

If after an acute upper respiratory infection basal sibilant and sonorous, or fine to medium moist rales persist over a long period and show no sign of clearing up even after weeks, the diagnosis of chronic bronchitis is generally made. The authenticity of chronic bronchitis, at least as a primary entity, is more and more being called into serious question. As a convenient term the expression is allowable but it must always be used with the mental reservation that there may be some other condition to which the chronic bronchitis is secondary. Chronic bronchitis exists, but frequently it masks something else.

To what then are such persistent basal rales due? First of all the situation requires a thorough nose and throat examination, calling to our aid an expert rhinologist plus the x-ray, for time and again the pulmonary pathology producing these rales is due to chronic infection of the tonsils or sinuses, particularly the latter. It is impossible to be too emphatic in urging such procedure, for no condition is more productive of ill health or more gratifyingly amenable to intelligent and radical treatment. To prescribe the usual barrels of cough-mixture, to say nothing of codein or heroin, in a condition which may be the forerunner of bronchiectasis, that most miserable of all diseases, is unspeakable. If, however, with persistent basal rales, we can find no evidence of chronic upper respiratory infection, we must think, especially in a patient of middle or later life, of the chronic passive pulmonary congestion of cardiac incompetence. But, do not say chronic bronchitis. These same rales, furthermore, may be all that

we can find in early bronchiectasis. It may be possible to make the diagnosis only by lipiodol injection and the x-ray. It is only in the more advanced stages of this disease, than which nothing is more provocative of wretchedness, that we find the text-book *richesse* of signs and symptoms (profuse, layered, foul expectoration, clubbed fingers, large moist rales, bronchial or cavernous breathing, recurrent broncho-pneumonia and chronic invalidism). All the more reason for discovering promptly and clearing up radically all chronic upper respiratory infection in your so-called chronic bronchitis.

The sibilant and sonorous rales of asthma are readily given their correct definition by the characteristic paroxysmal attacks, the expiratory dyspnoea, the eosinophilia, the Charcot-Leyden crystals in the sputum, the history of eczema, hay-fever, urticaria and the erythema multiforme group of eruptions, and the prompt response to adrenalin. Here, again, the search for upper respiratory infection is in order, although its removal will fail frequently to cure. Failing this, sensitization to foreign protein must be considered.

If, in the presence of cough with blood-streaked sputum and fever of subacute onset, we find numerous bilateral basal fine to medium moist rales, the diagnosis is probably broncho-pneumonia. Small areas of dullness may be difficult or impossible to find, but you may be able to pick up a small area of bronchial breathing or whisper, more likely the latter, as the unobtrusive bronchial breathing

tially a basal lesion, but may be so. Its diagnosis rests on a possible source of emboli (particularly mitral stenosis), a sudden onset, almost always with pain, not necessarily catastrophic or rapidly fatal but sometimes so dependent upon the extent of embolism and resultant shock, fever for a few days, sometimes high and septic, a few localized rales and possibly a pleural friction. Sterile emboli, if not promptly fatal from shock, end in recovery in a short time. Septic emboli terminate in abscess. It is appropriate to inquire into the source of the pulmonary emboli so frequent in mitral stenosis. To this question the student invariably answers, and very promptly, "from the mitral vegetations". At the next question, "How do they get to the lung?", there is a painful and embarrassed silence. We will leave it to the ingenuity of the student to figure out whence cometh the pulmonary emboli of mitral stenosis.

2. *Rales at the apex.* — Transient sibilant rales at the apex, which clear up after cough, mean nothing but bronchitis of the medium-sized tubes. The fact that such rales may not be heard over the rest of the chest, ordinary bronchitis possessing such general distribution, usually means that they have been present, but have cleared up while you were listening to the apex. If, however, apical sibilant rales persist, and no similar rales are heard over the rest of the chest, then think of the possibility of localized bronchitis, never forgetting that localized bronchitis is apt to be tuberculous. However, such persistent, localized, apical, sibilant rales are merely suspi-

cious, not diagnostic, of tuberculosis. In their presence other data are needed for a diagnosis.

Fine dry, or any sized, moist rales, at the apex, if persistent after cough, or if brought out by cough, mean tuberculosis. If such rales are moist, there may be demonstrable some change in percussion-note or breath-sounds. Here, however, the inevitable "*exceptis excipienda*" comes in. Very rarely such rales may, like localized harsh breathing, follow the grippe and last for several weeks, causing disastrous mistakes in diagnosis. Without a history of grippe, they are certainly tuberculous. And even with a history of recent grippe, tread softly, for the grippe probably was not grippe, but rather tuberculosis masquerading in sheep's clothing. In the overwhelming majority of cases such rales mean tuberculosis. If tuberculosis is suspected, they must be searched for with the greatest care.

3. *Generalized rales; (a) sibilant; (b) moist.*—Generalized sibilant rales mean bronchitis or asthma. Do not forget, however, that underneath the sibilant rales, and masked by them, there may be other pathology of a more serious nature, in particular, tuberculosis. The only way to protect yourself from the grievous error of missing the latter, is to train yourself into an attitude of chronic suspicion regarding the disease. The doctrine of the parsimony of causes, i e, the rule of scholastic logic which teaches us to look for single rather than multiple explanations of a phenomenon, may be all right in philosophy, but it is dangerous in diagnosis. Always watch out for

alternative possibilities. Generalized sibilant rales merely mean bronchitis. They do not rule out tuberculosis merely because they mask it. Such rales, if numerous and obtrusive, very often absolutely preclude any chance of diagnosing tuberculosis, either positively or negatively. If the history has shown anything of ominous suggestiveness, take an x-ray, and, of course, always, several sputum examinations. Physical examination, *per se*, is, in this situation, often hopelessly baffled.

These remarks apply, with even more truth, when we are dealing with generalized moist rales. Everything, even changes in breath-sounds, may be drowned out by the overwhelming tumult of the rales. The history, percussion and the whispered voice may help, but time and again, with this plethora of rales, we must fall back on the x-ray. Sputum examination is so obviously a matter of course, that no more than mere mention of it is needed. Some have said that the hardest types of tuberculosis to diagnose are the very early and the very advanced cases.

To sum up, generalized rales are both of the apex and of the base. Their differentiation must follow the criteria laid down for both of these localities.

4. *Rales over the hilum.*—Sibilant rales in this locality mean bronchitis. Fine dry or moist rales, if they are limited to the hilum and do not extend into the lower lobe, are almost certainly tuberculous. If they extend into the lower lobe, *without extending toward the apex*, they are less likely to be tuberculous. In this event, look for chronic upper respiratory infection, particularly of the

sinuses. If they extend up toward the apex, they are even more likely to be tuberculous than if limited to the hilum alone. Remember that in a small area limited to the hilum, you will probably get no help from the x-ray, for everything will be overlaid by the dense shadow of the mediastinum. Diagnosis rests on general clinical considerations, including history and *repeated* sputum examination, plus the all-important fact that rales limited to the hilum are most probably tuberculous. Negative sputum examination is of no value whatsoever.

5. *Rales of lobar distribution.*—These must be differentiated according to the criteria laid down for apical and basal rales.

6. *Rales over intermediate and unclassifiable areas.*—Not even an approximate rule can be laid down. They must be diagnosed in terms of every bit of available data

III. THE ACTUAL TYPE OF RALE

The descriptive classification of rales is a difficult and dubious subject. The difficulty lies not in telling what is so, but in avoiding saying what is not so. There are two definite psychological hazards which tend to confuse the issues right at the start. First, the inherent difficulty of giving an unambiguous description to sounds upon which several observers may differ legitimately. Second, the ever-present temptation, for the sake of saving mental work, to try to correlate a given type of rale with a definite type of pathology. From the very start the existence of

these two hazards must never be forgotten. The classification of rales and the interpretation of the rales in terms of pathology always must be to some extent provisional.

A practical tentative classification of rales and adventitious sounds can be laid down according to the following scheme:

- A. Dry rales.
- B. Moist rales.
- C. Pleural frictions.
- D. Muscle sounds.

A. Dry Rales

- 1. Sibilant rales
- 2. Sonorous rales.
- 3. Fine dry rales.

First of all, remember that there is no such thing as an actual *dry* rale. When we speak of dry rales, we mean rales that "sound" dry, in contradistinction to moist rales, which "sound" moist.

Sibilant and sonorous rales, also known as rhonchi.—Sibilant rales are musical chirps and squeaks of a dry non-sticky quality. Sonorous rales are non-musical snores and grunts. Sibilant and sonorous rales result from swelling of the mucosa of the large and medium bronchi with resulting narrowing of the lumen. They are, therefore, signs of bronchitis of the large and medium tubes, the ordinary common or garden variety of bronchitis. Bronchitis, however, may occur without their being present. They also occur in asthma. They are, therefore, associated with lesions which, *per se*, do not cause changes in

percussion-note or breath-sounds. But remember that lesions causing such changes may be present independently and be completely masked by the noisy sibilant and sonorous rales. As bronchitis usually is a bilateral disease, these rales are heard bilaterally, and as general bronchial congestion usually is more marked at the base, they tend to be more in evidence in that location. But, as they tend to disappear after cough and deep breathing, they may have cleared up temporarily during your auscultation of the apices, and you may, therefore, miss them when you reach the base. For this reason, when you suspect ordinary bronchitis, it is best to auscultate the base first.

Fine dry rales.— These can be imitated fairly well by rubbing a few hairs between the thumb and forefinger. If few in number and well separate from each other, they are referred to by some writers as "dry crackles", or "isolated crepitant rales". If many in number and occurring in small showers, they are known in the textbooks as "crepitant rales". The difference between dry crackles and crepitant rales is simply numerical. They are almost invariably limited to the inspiratory phase, very rarely appearing in the expiratory, and frequently require for their demonstration the cough at the end of expiration, a manoeuvre which always must be carried out. Now then, what do they mean? First of all, they are heard frequently at the extreme base posteriorly, or at the lower margins of any of the lobes, during the first few deep inspirations, after which they generally disappear. They are, in this situation, very certainly due to the

separation, by deep inspiration, of the opposed coherent surfaces of a few unused air vesicles on the extreme confines of the lung. Ventilation of these vesicles causes first the appearance and then the clearing up of these rales. In this situation they are referred to often as atelectatic or marginal rales. They are, however, true fine dry rales, and in other situations of the chest will have an entirely different significance. In the presence of pathology, they probably represent early pneumonic infiltration, the term "pneumonic" being used in its generic sense. At the apex they are presumptive evidence of tuberculosis. In other parts of the chest, *with appropriate symptoms*, they may be the earliest signs of lobar pneumonia. The absolute acoustic identity of fine dry (crepitant) and atelectatic marginal rales has tempted some speculative souls to explain their incidence in early tuberculosis as follows. A very early tuberculous bronchiolitis, which as yet has not reached the stage of free exudation, causes an occlusion of the bronchiole in question through swelling of its walls. The lack of ventilation of the vesicles distal to this bronchiole causes them to lose their contained air through absorption. Their walls collapse and cohere, become atelectatic in other words. The cough forces air through the occluded bronchiole, reinflates the vesicles tributary thereto, and separates their walls, with the production of fine dry rales identical in character and mechanism of production with the marginal rales so frequently heard at the base of the normal lung. The fine dry rales of early tuberculosis, in short, are produced not at the site of the

actual pathology, but distal to it. Now this is all very fine, but it is probably not true. This very plausible and attractive theory is very interesting to the metaphysical side of our nature, but it completely disregards the fundamental difference between marginal, ~~non-pathological~~ fine dry rales and apical, tuberculous, ~~early in the disease~~ fine dry rales, the former are transient, the latter are permanent. Later, when we come to take up the signs of disease, we will see that the fine dry rales of early tuberculosis are probably an outgrowth of a still earlier stage of the disease, breathing, this last being a sign which ~~can only arise in the actual site of pathology.~~ ~~the fine dry rales of early tuberculosis are not~~ but direct evidence of disease, and those referred to as an early sign, actually mean that the stage of open exudation has been reached.

B. Moist Rales

By moist rales we mean rales that are ~~not~~ The distinction between dry and moist rales is not easier to make out with the stethoscope than it is to describe in words. Moist rales are ~~not~~ described by the student as having a sticky, wet sound, and this is precisely what is meant.

We divide moist rales into:

1. Fine moist rales.
2. Medium moist rales.
3. Large moist rales.
4. Mucous clicks.

1. *Fine moist rales* are slightly larger than fine dry rales. They can be imitated fairly well by opposing and separating the balls of the thumb and forefinger after moistening them with molasses. They are usually referred to as subcrepitant, a term which should be relegated to limbo.

In general it may be said that moist rales represent a more advanced grade of exudation or transudation than do dry rales.

2. *Medium moist rales* are larger than fine moist rales. In general, the larger the rale the more pronounced the process, whether exudation, transudation, or caseation. Between these three processes, however, there is obviously a vast diagnostic difference, and since a medium moist rale may connote any one of the three, it is obvious that, except in very general terms, we cannot rely for our diagnosis on the mere definitive characteristics of the rale itself, but must refer to all the other data that have already been gathered, to wit, history, palpation, percussion and breath-sounds. The average medical student seems to feel that he has not gotten his money's worth out of a clinical session unless he has heard some rales, and when he does hear them he shows an expansively naïve delight at having, at last, found one clear-cut thing in a desert of obscurity. Remember that rales, although of the greatest importance, must, for the sake of developing technic, be relegated to a secondary position and be regarded for the most part as merely complementary to the other data.

There are two special types of moist rales which must be mentioned here. At times fine to medium moist rales

will have a high pitch and a curious, incisive, clear-cut, snapping quality, something like that of a toned-down telegraph receiver. These are known as consonating rales, and they derive their special characteristics by participating in the acoustic qualities of the tissue surrounding the site of their origin. You will remember that bronchial breathing is high-pitched and clear-cut. The similar characteristics of the consonating rales spring from the fact that these rales arise within tissue potentially capable of producing bronchial breathing, to wit, consolidation or cavitation, especially in broncho-pneumonia and caseating tuberculosis. Their presence signifies a high degree of intra-bronchial exudation, suggested by consolidation or cavitation. Actual bronchial breathing need not be present; the broad

the presence of pathology corresponding to

consonating rale, except that it is always never fine. Its unique feature is its quality, precisely like that of the ordinary. It is distinguished from the latter, however, most important, by being moist in some instances, infrequently over caseating tuberculosis, never heard it anywhere else. It must not be taken as a sign of a banal bronchitis.

It is unwise to put too much weight upon the phase in which the rales appear, whether inspiratory or expiratory. It is true that fine dry rales and the earliest fine moist rales are almost without exception limited to inspiration, and that, in general, an extension of the rales into the expiratory phase connotes a greater advancement of pathology. However, a pleural friction, which often indicates a comparatively insignificant or even healed process, quite frequently is audible in both inspiration and expiration, and, which brings us to the point in question, quite often is indistinguishable even to the ear of the expert from fine dry, or even fine moist, rales. In such a situation, if we put too much emphasis on the phase of incidence of the rales, the presence of adventitious sounds in the expiratory phase might lead us to the serious error of diagnosing a graver situation than actually existed. Take, for example, an extensive patch of inspiratory and expiratory fine dry and fine moist rales at the lateral or posterior base. How are we to distinguish between a comparatively trivial dry pleurisy, perhaps a healed dry pleurisy, from a far more significant intra-pulmonary lesion? By the history, by the symptoms, by the presence or absence of clubbing of the fingers, by the patient's general health, and, alas! by the x-ray. The greater the discrepancy between the negative symptomatology on the one hand and the prominence of the rales on the other, the more apt is the lesion to be extra- rather than intra-pulmonary.

3. *Large moist rales* mean the presence of a high degree of very liquid exudation or transudation, such as might

be expected in resolving pneumonia, advanced caseation or pulmonary œdema. Their significance is determined by the nature of the other data.

In searching for fine dry or fine moist rales, never fail to have the patient give a slight cough *at the end of expiration*, and after coughing, breathe in. This manœuver frequently will bring out rales otherwise hidden. They will make their appearance immediately after the cough or at the end of the next succeeding inspiration. The medium and large moist rales generally do not need the cough to bring them out. The cough frequently will demonstrate a valuable sign of cavity known as the post-tussic suction. Have the patient cough at the end of expiration, but this time have him hold his breath after the cough. Immediately following the cough, *and while the patient is holding his breath*, there will be heard what sounds like a short, high-pitched, blowing breath-sound, which, occurring while the patient is not breathing, must be due to some other mechanism. The cough compresses the walls of the cavity. Immediately after the cough, these walls, if sufficiently elastic, rebound to their original position, sucking air in after them, which sucked-in air gives rise to the sound in question.

If the rales are so noisy as to obliterate the breath-sounds, as frequently happens, try the whispered voice. This may bring to light an unsuspected situation the equivalent of broncho-vesicular or bronchial breathing, such as infiltration, consolidation, cavitation or fibrosis.

4. *Mucous clicks*.—The mucous click is a rather large

and very sticky moist rale. Its size and wetness have a rather ominous sound and suggest advanced caseation. It is due, however, to mucus in the small bronchioles around a healing tuberculous focus, and in fact may persist long after the actual tuberculosis is healed. It is, in short, a not unfavorable sign. It should always be checked by the x-ray to rule out an undemonstrable parenchymatous involvement. When the examiner hears it, he generally shakes his head in a learned sort of way and announces profoundly and gloomily, "There is moisture present", which is sufficiently non-committal. As a matter of fact the fine dry rale is infinitely more sinister, because it represents the inception, not the end, of a tuberculous process.

C. Pleural Friction

Most of the ammunition for this subject was expended in the previous paragraph devoted to the significance of the phase during which rales appear, whether inspiratory or expiratory. The main diagnostic implications are discussed there. The absolutely typical pleural friction is a dry, leathery, shuffling, back-and-forth sort of sound, possessing a much higher degree of continuity than rales, not influenced either positively or negatively by cough and heard in both respiratory phases. Unfortunately there are many exceptions to this cut-and-dried text-book description, and these exceptions are discussed above. At times the sound cannot be distinguished from fine, or even medium, moist rales. The mid-axillary region is the

usual site in which to hear friction-rubs, as here is the greatest amount of free play between parietal and visceral pleura. But they may occur anywhere, not infrequently indeed at the apex. Hearing them in this locality, it is a nice question to decide whether you are dealing with the extra-pulmonary signs of an old and obsolete tuberculosis, or the intra-pulmonary signs of an early and advancing tuberculosis.

D. Muscle Sounds

There is one perennial source of confusion, namely, muscle sounds. The student need not worry, however, because at times even an experienced man will mistake them for rales. Muscle sounds are a deep vibrant rumble, with a marked continuity, different from the sharply discontinuous, staccato explosions of rales, and they last all through the inspiratory and expiratory phases. In fact they seem to last beyond the expiratory phase, through the interval when the patient actually is not breathing at all, over into the next inspiration. They are ooisy and exasperating, but it is possible to cultivate a "deaf-spot" for them. They are less likely to occur in patients with a well-developed panniculus adiposus, which seems to blanket them off, and hence are less bothersome in women. Joint-crepitus often causes sounds very similar to rales and must be guarded against. A useful maneuver is to have the patient breathe in short gasps or sighs. This frequently will render less obtrusive both joint-crepitus and muscle sounds.

and very sticky moist rale. Its size and wetness have a rather ominous sound and suggest advanced caseation. It is due, however, to mucus in the small bronchioles around a healing tuberculous focus, and in fact may persist long after the actual tuberculosis is healed. It is, in short, a not unfavorable sign. It should always be checked by the x-ray to rule out an undemonstrable parenchymatous involvement. When the examiner hears it, he generally shakes his head in a learned sort of way and announces profoundly and gloomily, "There is moisture present", which is sufficiently non-committal. As a matter of fact the fine dry rale is infinitely more sinister, because it represents the inception, not the end, of a tuberculous process.

C. Pleural Friction

Most of the ammunition for this subject was expended in the previous paragraph devoted to the significance of the phase during which rales appear, whether inspiratory or expiratory. The main diagnostic implications are discussed there. The absolutely typical pleural friction is a dry, leathery, *shuffling, back-and-forth* sort of sound, possessing a much higher degree of continuity than rales, not influenced either positively or negatively by cough and heard in both respiratory phases. Unfortunately there are many exceptions to this cut-and-dried text-book description, and these exceptions are discussed above. At times the sound cannot be distinguished from fine, or even medium, moist rales. The mid-axillary region is the

attempted to describe in the preceding pages. Dealing with the detached topic of tuberculosis, it is necessary for descriptive purposes to abandon the inductive to a certain extent and resort to a more deductive method of approach. In the present chapter I will not differentiate between signs and symptoms, but will attempt to treat the subject as an organic unit.

The first part of the equipment necessary for the early diagnosis of tuberculosis is an unremitting, unrelenting, inexorable attitude of strong suspicion. Always think of tuberculosis. A young girl came to New York to buy a wedding dress. She consulted me about a cough, which she had had for a year. Her local doctor had squirted out her throat twice a week for twelve months. He had never looked at her chest. Examination showed innumerable fine and medium moist rales over both upper lobes, about twenty bacilli to each microscopic field and in the x-ray extensive parenchymatous consolidation and cavitation. The wedding invitations were called in. Now it may not be considered good literary form to indulge in what the art critics call "morbidezza" in a technical medical discourse, but this sort of thing is happening all the time, and all for the same reason, lack of suspicion. There actually seems to be what the psychoanalysts call a "resistance" against the idea of tuberculosis. It is almost as if "nice people" did not get tuberculosis. Well, nice people do get tuberculosis, and nice people get syphilis too, another disease which is missed as a result of insufficient evil-mindedness on the doctor's part. Always suspect,

CHAPTER XI

THE SIGNS OF TUBERCULOSIS

Sputum examination.
Pleurisy with effusion.
Significance of hemoptysis
Apical moist rales Intrequent sequel of influenza.
X-ray findings
Other symptoms
Percussion
Auscultation.

"A wicked and adulterous generation seeketh after a sign, and there shall no sign be given unto it"

This, the most profound of all the verses in the Bible, is directed against those of the human race, the vast majority, incidentally, who think that merit is to be acquired by some cheap and easy formula, rather than by prayer and fasting. It is highly applicable to the diagnosis of tuberculosis. There is no cheap and easy route. A positive sputum is, of course, a sure sign, in the Biblical sense, but it means a pretty well advanced process. Finding a positive sputum is not diagnosing tuberculosis. Any laboratory technician can do that. Diagnosing tuberculosis means the discovery of the process in the minimum of time so that the patient can have the maximum of chance. Tuberculosis is diagnosed by a skilled technic plus a peculiar synthetic discipline of the mind. This technic and this synthetic inductive discipline I have

attempted to describe in the preceding pages. Dealing with the detached topic of tuberculosis, it is necessary for descriptive purposes to abandon the inductive to a certain extent and resort to a more deductive method of approach. In the present chapter I will not differentiate between signs and symptoms, but will attempt to treat the subject as an organic unit.

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but do not make a definite diagnosis on suspicion alone. Such a diagnosis, fraught as it is with the most serious consequences to the patient, must be based on a convincing array of evidence. Voice your suspicions, if you must, without unduly disturbing the patient, but do not subject him to a revolutionary change in his life until you are sure

SPUTUM EXAMINATION

A positive sputum is an inevitable sign of tuberculosis. But be sure that the positive sputum is really positive. One single lonesome bacillus in fifteen minutes' search is pretty thin evidence unless the finding is duplicated in later specimens. It may be an artefact. Now, when should the sputum be examined for tubercle bacilli? The answer is, whenever there are cough and expectoration. It is very disconcerting to have an apparently ordinary lobar or broncho-pneumonia turn out to be tuberculous, and if to such a case you should have given pneumococcus serum or antibody, thereby stirring up the animals to the point of disaster, it requires a high degree of rhetorical skill to rationalize your way out of it. If, in such a situation, the patient's family say, "Doctor, did you examine the sputum?" and when you answer, "No", they continue with the question, "Well, why not?" or words to that effect, it is hard to know what to say. This procedure, so simple, so direct, so specific and confoundingly obvious, is postponed time and again and always for the same reason, a low index of suspicion *in re* tuberculosis.

A husky young city fireman came into the Bellevue Tuberculosis Clinic. His complaints were rather marked dyspnoea on exertion, very slight cough, very slight expectoration and a pulse of 100 with a normal temperature. Physical examination and the x-ray disclosed absolutely nothing, and I was stumped for a diagnosis, being perhaps inclined toward the dubious but convenient diagnosis of myocarditis, convenient, because no one can disprove it. I was considerably chagrined when the sputum was reported loaded with tubercle bacilli. Now here was where the wicked generation seeking after a sign scored on the toilers in the vineyard, and I breathed a prayer of gratitude that in the Bellevue Tuberculosis Clinic the sputum is examined as a routine, for I do not think it would have occurred to me to have done it myself. The answer is simple. My index of suspicion was not up to scratch.

Now what does a negative sputum mean? A single negative sputum means absolutely nothing, no matter what the attending circumstances. Repeated negative sputa, say a dozen or so, in the presence of very slight pathology, likewise mean absolutely nothing. However, repeated negative sputa, *in the presence of considerable pathology, and with considerable expectoration*, are strong evidence against tuberculosis, but only with these attending qualifications. The whole situation reminds one of Nigger Jim's conversation with Huckleberry Finn on the signs of bad luck, of which, you will remember, he recounted quite a catalogue. When Huckleberry asked, "Well, what are the signs of good luck?" Nigger Jim

replied, "Huck, I jex' reckon they ain't no signs of good luck." This is the attitude to take toward all negative laboratory findings, and the earlier this attitude is acquired, the better.

PLEURISY WITH EFFUSION

Pleurisy with effusion means pulmonary tuberculosis no matter if specific physical signs and x-ray findings are negative. Pleurisy with effusion is a specific physical sign of tuberculosis, and woe unto the physician who fails to accept it as such. Woe, also, unto his patient! The books say that 80 per cent. of all cases of serous effusion are tuberculous. But don't pay any attention to such a figure. Serous effusion actually means tuberculosis in about 100 per cent. of cases. It is a real, sure-enough, honest-to-goodness "sign" and should be sufficiently convincing to any generation, no matter how wicked, etc. Of course, serous effusion must be distinguished from other forms of pleural fluid, such as the non-inflammatory transudates of cardiac and renal disease, the sero-fibrinous pleurisy of pneumonia and empyema. These last will be distinguished by their physical and microscopic characteristics and also by their typical, concomitant symptomatology. Sterile empyema is almost invariably tuberculous

SIGNIFICANCE OF HEMOPTYSIS

Hemoptysis *almost* inevitably means tuberculosis. Ignoring this fact has occasioned innumerable tragedies. But, an hemoptysis must be an hemoptysis. A speck or minute streak of blood in scant sputum after violent coughing is not an hemoptysis. In such cases the throat-mirror will often reveal a fat cauliflower-like lingual tonsil with a lot of varicose veins. With luck, a small hemorrhage from one of these veins may be actually seen, if sufficiently recent. But a half a dram of free blood, particularly if full of air-bubbles, is a genuine hemoptysis. Having thus established the fact of hemoptysis, we automatically infer tuberculosis, but we are not yet in position to fill out an application card for a sanatorium. For the mere hemoptysis tells us nothing about the actual status of this particular case of tuberculosis, whether in the past, present, or future tense, whether early or late, whether obsolete or advancing. Consider the pathology of hemoptysis. It may be the initial symptom of an early active process in a supposedly healthy person, in which case it arises from a small area of ulceration in a minimal parenchymatous process. In such a situation it means *Danger*, and if this unequivocal signal be heeded, fortunate is the patient, for he will get on the job at once, mobilize his forces and get cured. If neglected, — !

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represent the early evidence of an advance of the old process into new tissue. It may come from the erosion of an artery in a cavity, in which case the hemorrhage may be acute and menacing. This is the frequently fatal type. Lastly it may arise from the sloughing out of a calcified area in a completely healed, inactive and obsolete lesion, and thus carry with it no menace at all. But one must tread softly in making such a diagnosis. Such a conclusion must be made with considerable caution and with the use of the best clinical judgment. In other words, although practically every hemoptysis (for there are exceptions) means tuberculosis, yet every hemoptysis has a meaning all its own and must be interpreted inductively in the light of all the data, history, physical examination, pulse-temperature record, weight and strength record and x-ray. Another possible cause is pulmonary neoplasm. If there are repeated hemoptyses and careful consideration of symptoms, physical examination and x-ray gives no explanation, bronchoscopy is in order. There may be a new-growth of the bronchi. Suspicious symptoms are chronic non-productive cough without fever but with progressive loss of weight and strength.

APICAL RALES

Persistent fine moist rales at an apex are practically pathognomonic of tuberculosis. Yet even this so sure sign must be checked by other evidence, so serious is the question at issue. Localized moist rales at an apex mean

localized apical bronchitis, and localized apical bronchitis means tuberculosis in the vast majority of cases. Yet even to this rule there may be the rare exception. In the influenza epidemic of 1917-1918 and 1918-1919, there were occasional cases in which localized apical bronchitis occurred, manifested by a small patch of fine moist rales. The natural and inevitable diagnosis was tuberculosis, but the point is that the rales cleared up in a few days, and careful follow-up with the x-ray and repeated physical examination disclosed nothing.

X-RAY FINDINGS

Lastly come the x-ray findings, but this is a subject apart, highly complex and full of variables. Suffice it to say that the only pathognomonic x-ray sign of early tuberculosis is the characteristic shadow of parenchymatous infiltration. To diagnose tuberculosis on the basis of so-called peribronchial infiltration is skating on thin ice. And yet, on these very meagre grounds, enthusiastic radiographers are diagnosing tuberculosis with a temerity and enthusiasm that would be admirable, were the diagnoses only correct. It is almost as if they were trying to show how good they were, how superior to the poor devil of a clinician with his crude percussion and still cruder auscultation. For, to diagnose tuberculosis on the basis of peribronchial infiltration is wrong. Peribronchial infiltration may be based on purely non-specific causes, such as chronic tonsillitis or chronic sinusitis. The usual

conventional hedge is, "Yes, peribronchial infiltration is tuberculosis, but it is not *clinical* tuberculosis." But, in the name of Heaven, about what is it that we are vexing ourselves, if not clinical tuberculosis? Everyone has "ein bischen" of "unclinical" tuberculosis, to coin a new word, and peribronchial infiltration does not even mean "unclinical" tuberculosis. Check your x-ray findings with your history and physical examination.

OTHER SYMPTOMS

Such are the pathognomonic signs of tuberculosis, positive sputum, serous effusion, hemoptysis, persistent apical fine dry or fine moist rales and the x-ray shadow of parenchymatous infiltration, I trust duly emphasized, and, I trust, duly qualified. Outside of these pathognomonic signs, the diagnosis of tuberculosis is purely inferential, and on the degree of probability depends the course to be followed, whether watchful waiting or complete limitation of the patient's activity. So serious is the latter step, however, not only because of its depriving the patient of earning capacity, but also because of its sinister effect on his morale, that the fixed policy should be that of an optimist, not, however, of the optimist who has been defined as a person who does not know what is coming to him, but the optimist who has the courage derived from knowledge. Chronic cough, fatigue, loss of weight and amenorrhœa, without obvious cause, require explanation, but too much must not be inferred from them. Chronic

cough, without chest signs, may be based on a number of things, particularly upper respiratory infection, such as chronic tonsillitis or chronic sinusitis. An enlarged lingual tonsil is a very frequent cause of chronic cough, and one which is almost as frequently overlooked. This cough usually is characterized by its insistent violence, a violence which is out of all proportion to the meagre expectoration it produces. Not infrequently it is associated with a sense of irritation referred to the substernal region, thus giving rise to the false impression that a tracheitis is present. All the cough medicines in the world will have no effect on it. Pulling the patient's tongue forward and looking down with a throat-mirror discloses the large cauliflower-like lingual tonsil, which, acting like a foreign body, causes violent attempts to get rid of it. The cure is simple and effective and has the added value of being a good therapeutic test. A few applications of concentrated ferric chloride solution will shrink up the lingual tonsil and cure the cough. Some care is needed, for if any of the solution drips onto the vocal cords, considerable unpleasantness will ensue. The patient pulls his own tongue out, leaving two hands for the doctor, one for the throat-mirror, the other for the applicator.

Fatigue and loss of weight and strength may be due to many causes, particularly focal infection, mucous colitis, syphilis, thyroid disturbances and psychoneurosis. Remember that hyper-thyroidism may be associated with loss of weight and rapid pulse. If these symptoms are associated with an afternoon rise of temperature or pulse-

rate, they take on an added and sinister significance, and the general situation may force a tentative diagnosis of tuberculosis even without the pathognomonic signs. You are between the Scylla of early diagnosis and the Charybdis of correct diagnosis and may the gods be with you.

We will now attempt to follow the changes in physical signs corresponding to the changes in the underlying pathology. It is not possible to establish a complete correlation between them. Attempts to do so always lead to a certain degree of arbitrary rationalization and this factor of error must be kept in mind always. The natural desire to explain things, to establish relations, tempts one to plausible theories which may not be strictly true, and the natural desire to link up signs and pathology is fraught with this risk. In the following description, bear in mind that the relationships, however arbitrarily expressed, carry with them a tacit qualification.

I. PERCUSSION

The earliest lesion consists of a few small scattered tubercles at the apex. Corresponding to this there is usually not true dullness, but a slight decrease in the duration of the note with a slight elevation of pitch. As the tissue surrounding the tubercles may be relaxed, there may be a corresponding slightly tympanitic or hyper-resonant overtone, which may, but usually does not, cover up the slight impairment of resonance. If the slight tympany predominates over the slight impairment we may

he misled into placing the presumptive lesion on the wrong side. These slight percussion changes are the very earliest signs and precede any auscultatory changes. They require for their recognition the most careful technic, even to the percussion of the two apices during the same phase of respiration. They are too fine-spun to have any pathognomonic value, but in the presence of suspicious symptoms pick up an added diagnostic momentum.

A slight retraction of the inner border of the apex can, in this stage, be demonstrated with more assurance. It is not due to fibrosis, which has not yet appeared, but to lessened functional activity, and with early cure may disappear. Impaired resonance over one aspect of an apex, anterior or posterior, may be accompanied by hyper-resonance over the other aspect. So, finding one, look for the other.

Actual dullness is not an early sign because it means that a fairly good-sized area of consolidation has developed. In percussion the apex must be divided into three zones, each of which is to be compared separately with the corresponding zone on the other side. The innermost zone shows a slight degree of tympany, derived from the closely adjacent trachea. The outermost zone shows slightly impaired resonance as a result of the underlying muscles. The central zone gives the lung tone, normally slightly modified of course on the right in the direction of impairment of resonance and heightened pitch.

The commonest sites of dullness are the inner part of the supra-clavicular fossa, the inner third of the infra-

clavicular space, and the supra-spinous fossa. Percussion of the clavicle itself to bring out the dullness of the lesion which at times occurs directly under the bone is unreliable.

Tympany accompanied by dullness is not necessarily indicative of cavity. As mentioned above, it may be due to relaxed tissue adjacent to a small area of infiltration. This tympany, unlike that of cavity, does not show Wintrich's sign (higher pitched percussion note with the mouth open) and may be thus distinguished. Unduly hard percussion at the apex may arouse tympany from the large bronchi and may lead to error.

With the advent of marked dullness, due to infiltration advancing toward consolidation, comes increased resistance to the finger on percussion, and the retraction of the apex border becomes more definite. Such marked dullness generally runs down from the outer end of the clavicle to the upper part of the sternum, forming a triangular area, the advancing border of which peters out into normal resonance. Below the area of dullness the lung is apt to be hyper-resonant, either from relaxation of tissue or from hyper-function. Outlying areas of dullness frequently occur in the fourth intercostal space. On the left, such an area may be found just outside the border of the heart. With advance of the disease retraction of the base occurs, with limitation of the motion of the diaphragm on the affected side. This is easily demonstrated by marking the lower limits of resonance in three phases, quiet breathing, deep inspiration and deep expiration.

II. AUSCULTATION

The earliest auscultatory changes are inspiratory, and to detect them, single-phase auscultation should be used, that is, the separate comparison of successive inspirations in symmetrical spots, without listening to the intervening expiration. The following are the earliest changes in the order of their appearance:

1. *Granular breathing*.—This is rough and low-pitched and is made up of a succession of very short sounds very closely spaced, without definitely distinguished intervals. It is probably due to slight narrowing or uneven surface of the bronchioles, and this always means parenchymatous trouble. It is entirely different from harsh or puerile breathing. It is most common in the following sites, in the order named: (1) the supra-spinous fossa, (2) the claviculo-sternal angle, (3) the supra-clavicular fossa, (4) the advancing border of disease. Muscle-sounds must not be mistaken for granular breathing.

2. *Diminished breathing* comes next in order, but is of less value diagnostically. It is due to obstruction by tubercles or mucus. It is of vesicular or slightly granular quality, and inspiration is feebler than expiration. To suggest tuberculosis, it must be limited to the apex and be persistent after cough.

3. *Cog-wheel breathing* generally is limited to the inspiratory phase. The respiratory murmur is divided into short periods separated by pauses, giving a sort of

(rough), feeble, or cog-wheel breathing, it is heard most often at the extreme apex in front

Prolonged expiratory sound without harshness is of little significance. Puerile breathing is not at all reliable. Undue transmission of the heart-sounds to the right apex is of considerable value, unless the heart is beating very hard.

5. *Rales* are not strictly incipient signs. They represent an advance beyond the signs considered above, and with them we reach the stage of *definite* auscultatory diagnosis. They likewise have their embryology and develop in the following succession:

(a) *Dry crackles*, or "isolated crepitant rales", are minute dry cracklings, three or four at the most, each well separated from the other and almost invariably limited to inspiration. They are permanent and are not removed by cough. At the apex they are presumptive evidence of tuberculosis.

(b) *Crepitant rales*, or fine dry rales, sound dry but are not strictly dry, as they are probably caused by the separation of alveolar walls which are stuck together by secretion. This is certainly the mechanism of their production at the base, where they frequently occur in normal persons on deep breathing and then are referred to as atelectatic or marginal rales, and this is probably the mechanism when they occur at the apex. In the latter situation they represent small areas of pneumonic infiltration. Acoustically the same as the marginal atelectatic rales heard at the normal base, they do not clear up on

deep breathing or on coughing, as do the latter, but persist. In fact, the cough often brings them out by explosively separating the coherent alveolar walls. They occur almost invariably in inspiration and are precisely the same as dry crackles, except that they are more numerous and occur in showers or salvos. At the apex they mean active tuberculosis.

(c) *Fine moist rales*, badly denominated "subcrepitant rales", are not limited to inspiration, but may invade the expiratory phase. They represent a further advance toward softening, but may occur in a healed or inactive area. The fine dry rale, however, invariably means activity.

For the diagnosis of early tuberculosis, rales must be strictly localized, usually at the apex, and persistent.

CONCLUSION

The goal of tuberculosis diagnosis is early diagnosis. Pathognomonic signs, even those conventionally denominated early signs, are not strictly early, for they represent a definite advance beyond the stage of actual beginning. True early diagnosis is a synthetic, not a rule-of-thumb, judgment and is based on all the available data. Quite frequently the only data available are those pertaining to the history. They must be interpreted in the light of a mature point of view, brought into high relief by an attitude of unrelenting suspicion, shaded by an attitude of critical caution.

APPENDIX

AUSCULTATION

As a complement to the otherwise exhaustive classification of rales on page 88, I must mention the wheeze. The wheeze I am about to describe is related, by the physics of its formation and its manifestation, to sibilant and sonorous rales, amply described on pages 100 and 101, but differs from them in many other respects.

Musical rales, generally, depend for their manifestation on the narrowing of the bronchial lumen, caused, of course, by swelling of the bronchial mucosa — hence the wheezing and rhonchi in chronic bronchitis and asthma. In these conditions the whole bronchial tree is involved. Naturally, the wheezes and rhonchi are heard over both lungs in all directions in almost equal intensity. There is no mistake about the multiplicity of these rales and the variety of quality and volume. The wheeze I have reference to is usually a single unilateral musical sound, synchronous with the respiratory sounds, limited to the upper lobe, loudest over the hilum. This wheeze is highly suggestive of tuberculous tracheobronchitis, and points to its probable presence when observed in a case of pulmonary tuberculosis but it is not pathognomic. This complication of pulmonary tuberculosis had not been well understood until about 1934. Since then, a wealth of literature and clini-

cal experience have accumulated to establish tuberculous tracheobronchitis as an important and serious complication of pulmonary tuberculosis. The wheeze justifies other methods of investigation, to be mentioned later, for confirmation of the diagnosis of tracheobronchitis.

The unilateral wheeze, too, may on rare occasions point to endobronchial neoplasm, which condition must be confirmed or denied by other tests.

BRONCHOSCOPY

Direct examination of the large bronchi has become an adjunct method of procedure in examination of the lungs, which is increasingly better understood and more widely applied. As the term implies, bronchoscopy is a procedure permitting endobronchial visualization of the main bronchi. This is accomplished by means of introducing through the larynx a long, straight metal tube, equipped with a light at the distal end and a magnifying ocular at the proximal end through which the operator examines the suspected field as he reaches the carina and the apertures of the two main bronchi. By this means of investigation, it is often possible to determine the cause of bronchial stenosis or occlusion. The most common causes for differentiation are: tuberculosis, neoplasm, foreign body, and kinking of a bronchus. It is only fair, for an understanding of the extent and limitations of bronchoscopy, to enumerate the possible findings in the various conditions mentioned

In tuberculosis, bronchoscopists have learned to recog-

nize the various stages of manifestation of this disease in the lower trachea and large bronchi. A tuberculoma, or ulcerations, offer no difficulty, even the early stages of infiltration, and the later development of scar tissue, though not unequivocal findings, are familiar to the experienced bronchoscopist. It must be remembered, however, that the diagnosis of tuberculous tracheobronchitis by bronchoscopy is only confirmatory in the light of highly suggestive clinical, physical, and roentgen signs.

In endobronchial neoplasm, bronchoscopy is the one of a few confirmatory measures that can promptly establish a definite diagnosis, both by direct visualization of the growth in situ, and by securing a section for microscopic examination. Kinking of the bronchus, and foreign bodies in the bronchi offer no great difficulty.

Limitations of Bronchoscopy.—In tuberculous tracheobronchitis, the diagnosis is easy when the disease is considerably advanced. The criteria for diagnosis of an early tracheobronchitis, however, are not so cut and dried that a diagnosis can easily be made by anyone who looks through a bronchoscope, but bronchoscopists of wide experience have learned to associate certain differences in the appearance of the bronchial mucosa with the beginning of this pathologic process.

In endobronchial neoplasms, the visualization of the growth is fairly simple when located in one of the large bronchi. In peripheral growths, bronchoscopy is of no avail. In order to illustrate to what extent bronchoscopy may be expected to yield confirmatory evidence of neo-

cal experience have accumulated to establish tracheobronchitis as an important and serious complication of pulmonary tuberculosis. The wheeze is a valuable method of investigation, to be mentioned in confirmation of the diagnosis of tracheobronchitis.

The unilateral wheeze, too, may on rare occasions be due to endobronchial neoplasm, which condition may be confirmed or denied by other tests.

BRONCHOSCOPY

Direct examination of the large bronchi is an adjunct method of procedure in examination of the lungs which is increasingly better understood and applied. As the term implies, bronchoscopy is permitting endobronchial visualization of the bronchi. This is accomplished by means of a larynx a long, straight metal tube inserted into the distal end and a magnifying lens at the proximal end through which the operator examines the field as he reaches the carina and the main bronchi. By this means of investigation it is possible to determine the cause of bronchial obstruction or occlusion. The most common causes are: tuberculosis, neoplasm, foreign body, or inflammation of a bronchus. It is only fair, for an understanding of the extent and limitations of bronchoscopy, to mention the possible findings in the various conditions:

In tuberculosis, bronchoscopists have learned

(bronchiectasis) can be readily demonstrated, and the degree and localization of the condition ascertained. Although bronchography has been sporadically used as an indirect aid in the diagnosis of other lung affections, it has proved most helpful as a *direct diagnostic aid* in cases of suspected bronchiectasis.

LABORATORY TESTS

In Tuberculosis.—The tuberculin test, although not strictly a laboratory procedure, may for the sake of convenience be included under this heading. A positive tuberculin test merely produces evidence of tuberculosis infection, but it is no definite proof that the disease process under investigation is due to tuberculosis. A negative tuberculin test, however, at once eliminates tuberculosis as the cause of the disease process.

The presence of tubercle bacilli in the sputum or in fasting stomach contents, demonstrated by direct smear, concentration, culture, or guinea pig inoculation is direct evidence of pulmonary tuberculosis.

The hemogram characteristic of active pulmonary tuberculosis is marked by a slight decrease in hemoglobin, red cells within the normal count, shape, size, and color, slight leukocytosis. An increase in monocytes, when associated with a lymphopenia is considered a dependable index of activity and progression of the disease.

The blood sedimentation rate is an essential indicator of the degree of tissue destruction. Obviously, it is not

those shadows are evidence at least of changes in the lung parenchyma, rendering it dense enough to stop the rays. The variety of patterns thus obtained is in direct proportion to the density of the tissues, the extent of involvement, and the location and the characteristic manifestation of the etiologic process. We have learned, in the course of years, to associate each one of a variety of x-ray patterns with an etiologic factor as the probable cause of the disturbance. It should, however, be emphasized categorically that no x-ray shadow on the chest film is pathognomic of a specific disease process, no matter how characteristic of that disease the shadow may seem to be.

With this understanding in mind, we can proceed to contemplate the more common x-ray manifestations on the chest film. While thus appreciating the limitations of the various x-ray patterns, we can also evaluate their importance in relation to other findings in order to arrive at a definite diagnosis in a given case. To this end a number of photographs of various x-ray chest films are presented, accompanied by a brief description of the cases they represent.

CORRELATION OF SIGNS LEADING TO A DIAGNOSIS

Thirteen cases of the most common chronic lung affections have been chosen, and their roentgenograms faithfully reproduced in the section between pages 142-3, for the purpose of illustrating diagnostic procedure. As these are completely worked-up cases from the records of the

Los Angeles Sanitarium, Olive View Sanatorium, Cedars of Lebanon Hospital, and my own former private practice, they offer an authentic basis for the evaluation of the various procedures in the diagnostic scheme

CASE 1

Age and sex. — 30 year old female.

History. — Gradual onset of cough and expectoration, fatigue, loss of weight and slight p.m. rise in temperature.

Physical findings. — Impaired resonance, diminished breath sounds, and fine, moist rales over the right apex.

X-Ray — see Plate II

Laboratory findings — Moderately rapid sedimentation rate. Tubercle bacilli in fasting gastric contents by culture

Diagnosis — Active exudative tuberculosis of apex of right lung

CASE 2

Age and sex — 31 year old female

History — No history of sickness until a year ago, when a routine x ray of the chest revealed evidence of tuberculosis. Although patient had no subjective symptoms, she was advised to enter a hospital, which she did.

Physical findings — Impaired resonance over right apex with amphonic breath sounds and posttussic fine rales.

X-Ray — see Plate III.

Laboratory findings — Moderately rapid sedimentation rate. Hemogram within normal limits Tubercle bacilli in the sputum.

Diagnosis. — Active pulmonary tuberculosis with cavity involving right apex.

CASE 3

Age and sex — 44 year old male

History — Cough and expectoration, fever, loss of weight, and hoarseness of gradually increasing intensity for the past two years.

Physical findings — Impaired resonance over both lungs with



PLATE I

This photograph presents roentgen evidence of normal lungs. Note that the intercostal spaces are clear except for a faint arborization representing the bronchial tree. This photograph incidentally also shows evidence of a healed primary tuberculosis: the Ghon tubercle is seen in the right sixth intercostal space anteriorly. The hilar shadows are appreciably refractile.



PLATE II

This photograph presents evidence of an early right apical infiltrative tuberculosis. Note that the intercostal spaces are clear excepting the right apex which is clouded by irregular, fuzzy shadows. In addition, two small highly refractile shadows are seen in the right fifth and sixth intercostal spaces, anteriorly, probably Ghon tubercles.

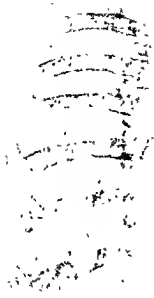


PLATE 117

This photograph presents evidence of tuberculosis with beginning cavitation spaces are clear excepting the right dense shadow and a definite ring space, anteriorly



PLATE IV

This photograph presents evidence of bilateral far advanced tuberculosis. Note that the upper two-thirds of both lung fields are clouded by dense, blotchy, stringy, and ring shadows.



PLATE V

This photograph presents a case of pleurisy with effusion. Note that the lower two-thirds of the left lung field are occupied by a dense, homogenous shadow. The left border of the heart is not discernible, whereas the right border shadow is seen appreciably over its normal limits in the right lung field.

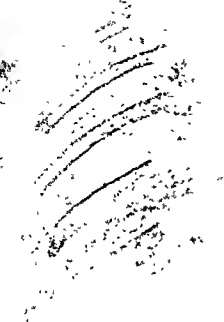


PLATE VIa

This photograph presents atelectasis of the left lung. Note that the left lung field is entirely occupied by a dense homogenous shadow. The heart shadow is indistinguishable from this opacity over the left lung field, and the right border of the heart is not seen at all.

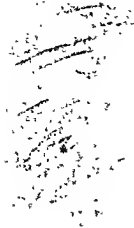


PLATE VIa

This photograph shows the same chest as in VIa after relief of atelectasis, now revealing shadows of caseous and cavitory tuberculosis of the entire left upper lobe.



PLATE VII

This photograph presents evidence of a spontaneous right pneumothorax. Note the clearness of almost the entire lung field, only the bony frame, and half of a pear-shaped opacity jutting into the field from the right sternal border and extending vertically from the second to the fifth intercostal spaces are seen. This opacity represents the collapsed right lung. Note also that the heart shadow is seen considerably to the left.

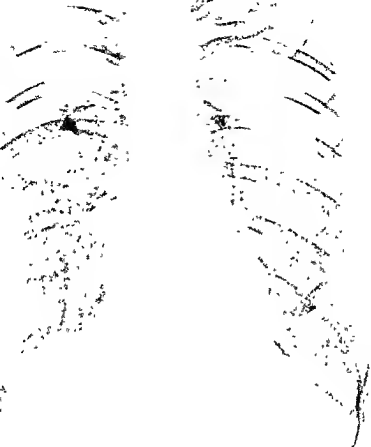


PLATE VIII

This photograph presents evidence of a bilateral simultaneous therapeutic pneumothorax. Note the line of demarcation between the air space and the collapsed lung on each side.



PLATE IX

This photograph presents evidence of a hydropneumothorax (in this particular case, pyopneumothorax). The extreme dense opacity over the lower two-thirds of the left lung field, abruptly limited above by a straight horizontal line over which a clear space is seen, gives the characteristic picture of fluid and air in the pleural sac, when the chest is X-rayed in the vertical position.



PLATE X

This photograph presents a large ballooned thin-walled cavity in the left upper lobe, and shadows indicative of diffuse infiltrative tuberculosis over the right upper lobe.



PLATE XIV

This photograph presents a dense homogeneous shadow over the right apical area. Otherwise the lung fields are remarkably clear. The roentgen analysis is atelectasis of right upper lobe. The tentative diagnosis is that of bronchial neoplasm.

SAMPLE TECHNIQUE IN DIFFERENTIAL DIAGNOSIS

The similarity of signs in two or more cases presented in the preceding section can hardly have escaped the notice of the reader. All I am anxious to emphasize in this section is the point of departure of one case from the rest by reason of differences. Proceeding, for example, in the conventional order, we begin by inspecting a chest and discover unilateral impairment or absence of respiratory excursion. Excepting paralysis of the muscles of that side, which we will exclude at once from our discussion, this sign suggests essentially an airless lung. Such a condition may be due either to collapse of the air vesicles by reason of a block in the main bronchus to that lung (atelectasis), or to a collapse of the air vesicles by reason of external pressure exerted by either fluid (effusion) or by air (pneumothorax), or by a combination of fluid and air in the pleural cavity (hydropneumothorax).

Palpation reveals that the tactile fremitus has been considerably diminished or is entirely absent on the affected side of the chest, thus confirming the suspicion aroused on inspection. But on percussion, the finding of hyperresonance over that side of the chest at once points to a diagnosis of pneumothorax and excludes the other three conditions from the field of suspicion. Let us assume, however, that on percussion, we find dullness to flatness over that same half of the chest, pneumothorax would then be immediately eliminated and the field would narrow down to the remaining three conditions. On auscultation, we

lesions or additional lesions running concurrently with the main findings just described. On closer scrutiny, however, we find that the rest of the lung field is clearly devoid of any shadow. If, now, we are given the history of onset, we find that this patient's disease had a stormy and rather sudden beginning, which is not the rule in pulmonary tuberculosis. We would, therefore, naturally lean towards a diagnosis of lung abscess. At this point, we desire to know the results of sputum examination. We find that although there is an abundance of mucopurulent sputum, which undoubtedly comes from the lesion area, it is by all standards negative for tubercle bacilli. Then, in order to eliminate tuberculosis definitely as the possible etiologic factor, we subject the patient to an intradermal tuberculin test and obtain a negative result. Now our field has been limited to lung abscess or neoplasm. A bronchoscopy at this point not only fails to reveal any endobronchial growth, but is incidentally the means of evacuating a considerable quantity of pus, through the right bronchus, which proves to be fetid. This procedure establishes a reasonably certain diagnosis of lung abscess, although it does not absolutely exclude neoplasm; the further course of such a case will, within a short time, definitely confirm the diagnosis of lung abscess, due to anaerobic infection, as differentiated from a complication of a disintegrating tumor.

A starting point for differential reasoning can be found in any one of the cases presented. Proceeding from such a basis, sound evaluation of the indications obtained through

various methods of investigation will permit the gradual narrowing down of the field of suspected conditions within a certain group sharing a number of symptoms and signs. Thus, we eliminate progressively the suspected conditions one by one, until we reach the one pathological entity which is unequivocally responsible for the disturbance under consideration.

It cannot be attempted here to describe all the variations under which a case may be presented to the physician for diagnosis. Under certain conditions, the method of exclusion that has been briefly outlined in the foregoing may start from any obtruding sign. Whenever possible, however, the orthodox order of procedure from inspection, palpation, mensuration, percussion through auscultation is preferable. The evidence thus obtained will indicate further steps of investigation by means of laboratory tests or other examinations, until the field has been narrowed down and finally reduced to one specific pathological process.

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